Garden Cities of the 21st Century

A. Bruce Etherington
December 2011

Submitted toward the fulfillment of the requirements for the Doctor of Architecture Degree.

School of Architecture
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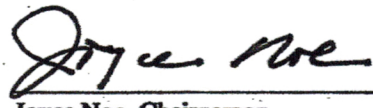
Doctorate Project Committee



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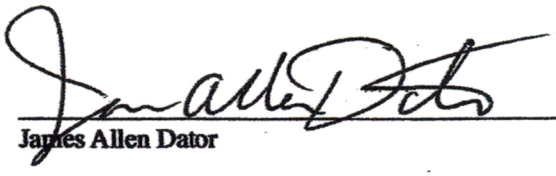

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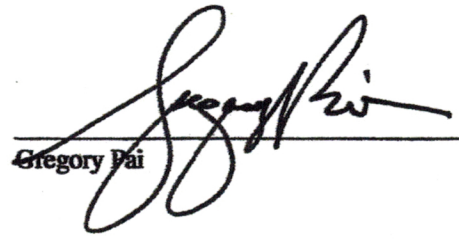

Gregory Pai

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Abstract

It has been more than 100 years since Ebenezer Howard published his epochal book on social reform that ultimately won him world recognition. Published first in 1898 as *'Tomorrow: A Peaceful Path to Real Reform'*, it was followed by revised publications in 1902, 1946 and 1965 under its present more evocative title, *'Garden Cities of Tomorrow'*. The multiplicity of editions testifies to a continued interest to secure a harmonious existence between humans and their natural environment.

Influenced by the conventional wisdom of the time, deviations from the original 1898 publication by Howard of his town plan and his social and financial proposals affected the design and implementation of the prototype city of Letchworth built in 1903. Ignoring the drawings and writings of Howard's book, the Letchworth model, because it was completed within the lifetime of Howard, was seen and accepted as the de facto model from which future garden cities could be reproduced. Duplication of the Letchworth prototype in Europe and North America, as a result of the deviations, led to incomplete, inaccurate or dysfunctional replications. The Letchworth concept of garden cities must be considered to have failed to reach the goal Howard had hoped to achieve: a distribution of sustainable, benign urban environments with an equitable and wholesome quality of life in a rural setting.

More than a full century has elapsed since Howard wrote his book and the world has entered a new millennium. New technologies, changing demographics and, most importantly, emerging social and environmental circumstances raise the possibility that the concept of garden cities could be revisited to determine that, if adapted to meet the constraints and needs of the 21st century, could reach the goals envisaged by Howard. To reach this goal would require a return to the writings and drawings of his original work, *'Tomorrow: A Peaceful Path to Real Reform'*, and a departure, independent of previous attempts to interpret the content of Howard's dream for all societies.

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Prologue

Howard's prime contribution was to outline the nature of a balanced community and to show what steps were necessary, in an ill-organized and disoriented society, to bring it into existence."Lewis Mumford, 1964

An architectural student design project for the restoration of Hoc Mon, a small provincial capital city in Vietnam, renewed my interest in the Garden City proposal of Ebenezer Howard. Located 20 kilometers south of Saigon, Hoc Mon had been badly damaged in the north-south civil war and had become a warren of narrow twisting lanes and low rise semi-derelict mostly wooden housing and commercial structures. These had enveloped all vacant urban land to ultimately lap at the very doorsteps of a very old and much revered temple, a squalid traditional covered market and a staid government office building. Faced with a morass of narrow muddy lanes and unpainted, decaying wood, the students chose to rebuild or relocate the offending housing and other structures at a significant distance from this group of civic icons and to create a central open space to provide a comprehensive view of the triumvirate of government, commerce and religion that traditionally mark the heart of a city. By redistributing or building anew in this manner, the relocated and new buildings formed a closed faceted loop that bore some resemblance to the Garden City in the publication of Ebenezer Howard, *Tomorrow, a Peaceful Path to Real Reform*. The successful conclusion of the student project stimulated me to a more careful review of Howard's publication that revealed an alternate path to that offered by planners and architects of that day and an intuitive thought that, had Howard's Garden City proposal been more closely considered at the time it was published, a radically different planet and a possibly superior quality of life might have materialized.

My curiosity aroused, I made the long journey from my home in Hawaii to see Letchworth, the first built Garden City to validate the reality of what I had envisioned after reading the enthusiastic description and inspecting the beautifully detailed drawings in Howard's first publication of a garden city: *Tomorrow, a Peaceful Path to Real Reform*[i]. Arriving at Heathrow Airport in London, I collected my baggage and a rental car and drove, following my road map, toward Letchworth passing, en route, through a sun warmed rural countryside and, unexpectedly, into what appeared to be a nondescript middle class suburban sub-division similar to the many suburbs sprawled across North American and Western Europe. Thinking I was lost, I stopped to ask for directions to reach Letchworth only to be politely informed that I was already in Letchworth.

There followed a period of several days during which I scoured Letchworth looking for any physical vestiges of the plans and descriptions in *Tomorrow, a Peaceful Path to Real Reform*. Apart from some older smaller houses in isolated locations that suggested some connection with an earlier era, there was no sign of the many features that Howard described in his book. There was only sporadic evidence of an encircling agricultural belt, no broad circular 120 feet wide avenues or boulevards, no circular 'Crystal Palace' mall and no grand central park. What I found instead were networks of broad meandering roads stretching far beyond what could be considered a reasonable walking distance to reach the town centre with its central business district of clogged traffic, insufficient parking and a railway station on a railway track that cut through the town leaving a bifurcated amorphous urban form made functional only by automobiles. The possibility that the Garden City described in Howard's *Tomorrow, a Peaceful Path to Real Reform*

might be adapted to conditions and circumstances different to those that prevailed in England at the time that Howard's book was first published in 1898 posed a question. Could Howard's proposal for building Garden Cities and for combining constellations of Garden Cities into what Howard called Social Cities be adapted, in the 21st century, to the cultures and environmental circumstances in both developed and developing countries? Could such a proposal help to solve the shortages of housing in the developing world, reduce the abuses inflicted on our environment by massive uncontrolled urbanization and concentrations of congested polluted, unhealthy, cities? Could urban settlements be designed to fit into rather than to trample upon the natural environment? If so, how could such a bold step be accomplished and what changes would result to the natural and man made environments and the way of living in what might be a radically changed world?

The answers to these questions may be embedded in *Tomorrow, a Peaceful Path to Real Reform*. Eight of the 14 chapters of this book are directly or indirectly devoted to organizing and implementing the social, financial and physical conditions that had to be met to achieve a successful Garden City. The sources from which Howard pieced together the goals and plans for his Garden City are all identified in his book[ii] except possibly his three magnets [iii] and the creation of his circular city. Dismissed by his peers and the public as merely diagrams, they are detailed written and carefully drawn plans intended to bind together his financial, social and civic goals with a simple, inexpensive compact urban form that would reinforce the creation of the homogenous communities envisaged by Howard.

In his introductory remarks to the 1946 edition of *Garden Cities of Tomorrow*, Lewis Mumford, an eminent scholar, author and critic of the city and its history, observed that "Howard's prime contribution was to outline the nature of a balanced community and to show what steps were necessary, in an ill-organized and disoriented society, to bring it into existence."[iv] From this remark emerged a hypotheses that asks if Howard's proposal, had it been adopted, could have been successfully adapted to the circumstances of the 21st century.

Chapter I

The Parlous State of Human Settlements

[conurbations] spread geographically into a network.. that traverse the countryside [until] many countries begin to resemble the Northeast 'corridor' [v] of the United States. Margaret Catley-Carlson, 2000

A Brief Review

In Western Europe, human settlements[vi] (a generic reference that includes cities, towns, villages and hamlets) in pre-industrial times were small, transport was limited in range and scope, electronics were non-existent, water was retrieved and waste was discarded manually, socio-religious and market activities determined open spaces and impromptu lanes and defensive walls configured cities and towns. As populations grew and defensive city walls fell to the destructive power of gun powder, cities spread haphazardly beyond their original boundaries, leaving spontaneously created footpaths, byways, informal market spaces and religious and civic structures in their wake. As cities grew, their plans became more ambitious. A plan for Paris conceived in the 19th century, epochal in scale, concept and scope pointed the way toward integrating urban design with infrastructure through underground sewer lines under the newly built avenues.

With the advent of the Industrial Revolution cities, with their explosive industrial and population growth, were transformed in a most expedient manner: the pre-industrial footpaths and byways became stone paved roads to accommodate wheeled traffic and to carry waste and sewage in open gutters to the nearest river, lake or sea. The signature product of the industrial revolution, iron, was fabricated into a new product- cast iron pipe to carry and distribute water and dispose of water born waste. To avoid being underfoot, the iron pipe was buried below ground, while the most expedient and least costly way to conduct electricity was through wires draped overhead on wooden poles or tacked to the faces of buildings. These methods to collect and dispose of wastes and to distribute water, electrical power, and later, electronic communication and vehicular traffic, have proved to be woefully inadequate. These inefficient methods were unable to cope properly with the magnitude of urban sprawl and the advent of the personal automobile. As a result of continued world population growth, largely in the rural areas, cities and towns became bloated versions of their former selves as massive, often uncontrollable waves of migrants from rural areas overwhelmed their hosts to overcrowd existing housing resources and to extend existing city boundaries to accommodate new subdivisions and colonies of squatter slums.

Careless physical planning and loose dispersions of built environments, the legacy of 20th century planning,[vii] have resulted in an insensible loss of much needed but unappreciated natural and agricultural environments. Planners and policy makers often did not take into consideration the long term effect of their plans that led to increased energy consumption and pollution due to imbalances between the distribution of jobs, schools and homes and ultimately to the creation of unsightly, spoiled and depleted natural environments. Uncontrolled or poorly thought out or administered plans allowed the standards of design and construction quality to be often ignored. The location, the quality of infrastructure and construction of shelter were often not sited or built to withstand the natural disasters of forest fires, earthquakes, floods,

hurricanes or tornadoes that brought huge and unpredictable damage to settlements; the costs of which were invariably paid by the community at large.

The Conurbation Phenomena

From these origins emerged, in the closing years of the 20th century, conurbations, a term coined to describe the merging of suburbs of neighbouring towns and cities, whose combined expanse, in all directions, could be measured in miles and whose populations could be counted in millions. Seen from above, conurbations appear as incoherent collections of densely inhabited encampments from which extend tentacles of industrial, commercial and housing developments, interspersed with broad swathes of green fallow fields, punctuated by occasional brown patches of toxic soil, that stretch out in all directions to reach far into the surrounding hinterland. Conurbations, the step child of the Industrial Revolution, are the direct consequence of the uncontrollable growth of world population, of rural to urban migration and rampant industrialization that continues up to the present in the nascent industrial centres of developing countries, as they emerge from agricultural and resource extraction economies, to begin their own industrial revolution and to build their own conurbations.

To reach the far flung suburbs of conurbations with electric power, fresh water and to dispose of waste required extending wiring systems to access electric power from distant power sources, to retrieve fresh water from ever more distant lakes and rivers via buried pipes and human scaled concrete tunnels, to dispose of waste in expensive disposal plants or in distant hinterlands and to build systems of expressways to connect the far reaches of conurbations. Buried deep in the ground in tunnels, or elevated above ground on continuous bridging to escape the snarled traffic at ground level, these systems were the new forms of urban infrastructure that intruded into pre-industrial urban landscapes of open spaces and roads. The overhead expressways, built above existing neighbourhoods, transformed natural daylight into twilight that, together with the tangled skeins of overhead electrical, telephone and cable wires draped on utility poles, diminished and degraded urban spaces and vistas, leaving infrastructure as the clear winner in the division of urban space between functionality and the need for human affinity with nature to raise an unanswered question: what is the ultimate morphology of conurbations and how will the growing alienation between humans and their natural environments be managed?

Conurbations, because of their enormous populations, have the resources to support a large array of entertainment, education, cultures, shops, sporting venues and opportunities for employment. These are the magnets that continue to attract migrants from rural areas to become conurbation residents. But there are also an equal variety of perceived problems to temper the quality of life in conurbations. In their sheer hugeness, conurbations separate their inhabitants from unsullied natural environments, an intervening infrastructure oppresses the urban landscape and the monotony of endless vistas of treeless concrete and asphalt roads cluttered by endless traffic jams and lined with walls of faceless flats rising high into the sky exacerbate the loneliness of anonymous individual identities to negatively impact the psyche of their inhabitants. These perceived problems are made all the more depressing when experienced by the working poor living in single room households located in subdivisions so remote that it requires, for many, a 2 to 3

hour ride on public transport to reach their place of work. The derelict poor and the squatters who live in makeshift shelters made from scrap lumber and rusted sheet iron, tucked away in grimy pockets of poverty spotted throughout and around the perimeter of built up urban areas and in the accumulated detritus and filth of cul-de-sacs in the urban core also suffer an abysmal existence. Do these deplorable conditions that, on average, affect more than half of total urban populations world wide, portend a future when all human settlements will have been swept up to become conurbations and conurbations are combined to become "[urban] corridors" that are the final manifestation of uncontrollable urbanization that will provoke consequences to the quality of future life too draconian to contemplate? [viii]

The ills that afflict conurbations stem largely from their origins: muddled collections of former cities, towns, sub-divisions and colonies of squatters, whose former urban circumstances and zones are lost in massive population growth, blurred boundaries, and disparate infrastructure. Plans to contain or direct growth, to zone land use and to consolidate infrastructure and services are often frustrated by an inexorable flow of migrants, invasions by squatters, the anarchy of aggressive land development and the high costs of infrastructural improvisations or renewals. Remedies to these problems tend to be superficial: the real cause of problems may lie with the inherently dysfunctional conditions to be found in conurbations.

Resolving the functional problems of conurbations, composed largely of formerly independent municipalities often with a wide range of demographics and aging infrastructures, is a formidable and costly task. As a consequence, solutions to problems confronting conurbations rarely go to the underlying cause of the problem. To do so would require physically excising the problem and to replace it with a holistic solution that would better integrate with the existing circumstances and future plans of a conurbation master plan but that also would far exceed the cost of building anew. Conurbations, because of their magnitude, complexity and inter-dependence among former municipalities and the major costs that are required to resolve their underlying problems inevitably resort to compromised solutions that only temporarily solve urban problems and that continue to be a recurring maintenance cost.

The lists of problems that presently afflict existing human settlements are effects and not causes of the problems. The cause of present problems, it is now clear, is the conflict for space between infrastructural and human living spaces and of random zoning or the lack thereof, that leave vast separations between functions that need to be more closely linked, particularly between home and workplace or school. These shortcomings manifest themselves most overtly in traffic congestion and breaches in the delivery of utilities both of which need burrowing deeper and longer tunnels to extract resources, to extend existing utilities to serve new remote communities and to construct underground and elevated expressways to attempt to solve vehicular overloading of existing grade level roads. These alternatives are extremely costly and inevitably compromise the quality of urban space, but fail to achieve the desired efficiency simply because between the time a solution is first considered to its completion, the growth of vehicle population will have already overtaken the planned capacity of the yet to be completed road system.

The volume of new road vehicles increases proportionally to the world birth rate, rural in-migration and the increasing affluence of populations in conurbations that combine to make road traffic a perennial

problem. With residential neighbourhoods and schools and commercial, institutional and industrial employment scattered throughout conurbations, only a few workers and students can walk to their place of work or study, leaving the balance to face the daily task of reaching their destination by other means, e.g., bicycle, motorcycle, automobile, bus, taxi, light and heavy rail. Of these only light and heavy rail escape the tyranny of the traffic jam and in many cases, light rail competes with road vehicles for on grade road space, leaving heavy rail trains underground or elevated as the only viable alternative to facing traffic jams. But heavy rail is sparsely distributed and is rarely a multi-access system requiring passengers not living within walking distance of a rail station to 'drive-park-ride'.

Population Migrations

Prior to the Industrial Revolution, populations lived largely in rural areas where they worked the land to feed themselves, the small populations of town and cities or country estates. With the advent of a still continuing Industrial Revolution, rural populations began to move to urban centres, where better working conditions and wages prevailed. In matured countries, the ratio between urban and rural populations has reversed so that a rural population of around 20 %, now feeds an urban population of around 80% and yet, in spite of this reversal, agricultural productivity, has increased due largely to mechanization and agro-industrialization. This rural/urban population ratio has stabilized because agriculture has become a mechanized industry in which small subsistence or market farms, except for a few countries that still subsidize traditional farming methods, have been consolidated into large fully mechanized farms of monoculture agro-industries that make manual agriculture labor superfluous. This phenomenon continues in developing countries as small farm holdings continue to be swallowed up by international agro-industries, to provoke a continuous flow of former agriculture workers and artisans to already overburdened urban centres of developing countries. Based on the general conditions found in still developing countries this flow maintains a rural/urban ratio which hovers worldwide around 60% to 80% rural to 20% to 40% urban, assures a steady inflow of rural migrants to urban centres that will continue for some years until a ratio of around 20 per cent rural to 80 per cent urban is reached. This continuing flow of rural migrants when added to present natural birth rates is projected by the United Nations to increase total world population from the current 7 billion to 9 billion leaving millions of poor yet to be housed and fed within a very short period of time,[ix]

Human Settlement Options

At present the only apparent way to house humans appears to be by absorption into emerging conurbations and '[urban] corridors' which will most surely further degrade the overall quality of life and, with the voracious consumption of mostly agricultural lands that conurbations customarily consume, will certainly affect the world supply of food. These concerns have been apparent for some time and proposals to meet this dilemma regularly appear in the media. These span a spectrum ranging from urban towers sparsely distributed to avoid congestion and sufficiently high and wide to house populations in the thousands to, at the other end of the spectrum, an unending continuation of sprawling conurbations and '[urban] corridors'. Early and extreme examples of urban towers are the mile high tower of Frank Lloyd

Wright and the Ville Radieuse of Corbusier[x], whose chief characteristics were, next to their utter starkness, their alienation from the natural environment. More modest and practical are the medium height towers of the island cities of Singapore and Hong Kong which have multiple residential towers as their signature characteristic and, unlike the single tower city model, share a documented history and an authoritarian style of planning. Both Singapore and Hong Kong provide living laboratories to study human adaptability to 'vertical' living, with towers of varying heights within the limits of a small islands that, notwithstanding the paucity of open space, have managed to provide sufficient variety of building heights and open spaces to reduce the sense of overcrowding.

Between these extremes lies the opportunity to create human settlements that choose a middle way: planned communities that will assure adequate agricultural lands, efficient transportation of goods and people, embedment in a healthy and natural environment, and the judgmental allocation of natural resources to assure a balanced and continuing partnership with nature. Nature is life and life is resilient. It has withstood the depths of immobilizing cold and the heights of searing heat. It survives by transforming itself to meet continually changing environments. Planning human settlements requires a similar malleable approach to transformation in a continually evolving process in which human settlements are reduced to their essential elements in order to be re-arranged to suit the dynamics of their time and place.

Chapter II

The Missing Garden City

A Garden City is a town designed for healthy living and industry; of a size that makes possible a full measure of social [and sustainable] life, but not larger; surrounded by a rural belt; the whole of the land being in public ownership or held in trust for the community. Ebenezer Howard, 1898.

Western European countries were radically transformed in the 19th century by the discovery of how to harness the accessible and plentiful natural energy source of coal to a newly invented energy converter, the steam engine, to make motive power. From this union came a wide variety of applications ranging from the steam driven locomotive, machines to replace human energy to mass produce goods, and machines to make other machines, such as machine lathes to make cannons and metal pots. Through exploration and by virtue of their superior technology, colonization by Europeans of the Americas and Africa and the establishment of nationally abetted trading posts of private European companies throughout the Far East had been enabled.

Mechanization of factories and mass production of manufactured goods, widely recognized as the Industrial Revolution[xi], occurred in Britain during the 19th century. Accompanying this technological upheaval was a less well-known but equally profound social upheaval that affected the lives of British rural farmers, workers and artisans. During this period, the British Empire had reached its zenith, encircling the globe with colonies from which were imported raw materials and crops extracted or grown by cheap indigenous labour. These imports were converted, with the aid of the newly invented steam engine, into manufactured goods or foodstuffs for internal consumption, for export back to their colonies or to other countries. Due to less costly imported commodities and mechanized production, this cycle disturbed the existing traditional agricultural and cottage industry economies in rural areas and villages[xii] of England to create a reservoir of under-employed artisans and farm labourers. Known as the Victorian era[xiii], it was a time of transition from a rural agricultural to an urban industrial economy.

Factories, some incorporated into existing towns and cities and some with newly built factory towns that included worker's housing, emerged to facilitate the mass production of imported raw materials into manufactured products and processed foods more cheaply and faster than was possible by traditional agricultural farms and cottage industries. Workers needed to operate the machinery, recruited largely from among under or unemployed agricultural workers and rural traditional arts and crafts artisans, provoked massive, prolonged waves of migrant workers to urban centres. Existing low-income urban accommodation in cities and towns was quickly saturated, leading to overcrowded, unhealthy slums and the creation of a new urban working underclass[xiv]. The harsh reality of a marginal existence in the over-populated slums of London[xv] magnified the disparity between the ensconced middle and upper classes and the working class poor trapped in grimy tenements and slums.

This upheaval provoked a sharp response from the traditional agricultural and cottage industries that, up to that time, had been the main suppliers of foods, goods, and services to the British public. Reinforced

by the writings of Ruskin and Morris[xvi], the response coalesced into the Arts and Crafts movement[xvii], engaging traditional artists and craftsmen and urban intelligentsia in a struggle to stave off the onslaught of an irresistible machine age and to return to a fast disappearing bucolic life style [xviii]. Led by would be Bolsheviks, philanthropic societies and concerned citizens, ways to ease the life of the working class poor were sought.

The Ebenezer Howard Model

Among the concerned individuals was Ebenezer Howard who, single-handedly, produced a strategy, plans, and a book[xix], to help the working class poor escape the slums of London. There was little in Howard's background to suggest that the impact of his book, '*Tomorrow, a Peaceful Path To Real Reform*' first published in 1898 and in succeeding editions in 1902, 1946 and 1985 with the more evocative title *' Garden Cities of Tomorrow'*, would remain a standard by which the quality of contemporary life in the developed world is still measured. Born to parents of modest means, Howard at 15 years of age became a clerk. Dissatisfied with his prosaic life, he migrated to America at age 21 to become a farmer: a vocation at which, after one year, he quit to return to urban life, first as a shorthand clerk in Chicago for 4 years and after, when he returned to London, as a Parliamentary reporter. He remained at this post for the rest of his life. These experiences, combined with an avid interest in publications[xx] that covered a broad range of manifestos, pamphlets, and books relating to the problems of 19th century European society and by mingling with zealots, humanists and futurists, obviously contributed to the content of *'Tomorrow, a Peaceful Path To Real Reform'*. But Howard, in spite of his studies and talent, never acquired professional status in any of his broad range of interests, leaving him severely disadvantaged when dealing with professional colleagues in the execution of his concepts.

To introduce his strategy for ameliorating the plight of the rural poor left derelict by the industrial revolution, Howard used a simple analogy to illustrate this problem. In his publication, Howard described this phenomenon in terms of two magnets: populations driven to choose between a rural or an urban existence. To this dichotomy, Howard introduced a third magnet: an urban existence within a rural context: a city embedded in the countryside. The third magnet, based on the triad of a socialist lifestyle, communal finance and management and a built environment conducive to healthy living, consisted of a few simple precepts: moderately sized towns surrounded by supporting agricultural lands; residential areas proximate to public, commercial and industrial activities for easy pedestrian access; strict density control and ultimate population limits; spatial harmony between circulation, function and civic design combined with a rational and fair socio-economic finance and a management scheme based on all lands being held in trust by and for the community[xxi]. In Howard's words - "A Garden City is a town designed for healthy living and industry; of a size that makes possible a full measure of social life, but not larger; surrounded by a rural belt; the whole of the land being in public ownership or held in trust for the community"[xxii]

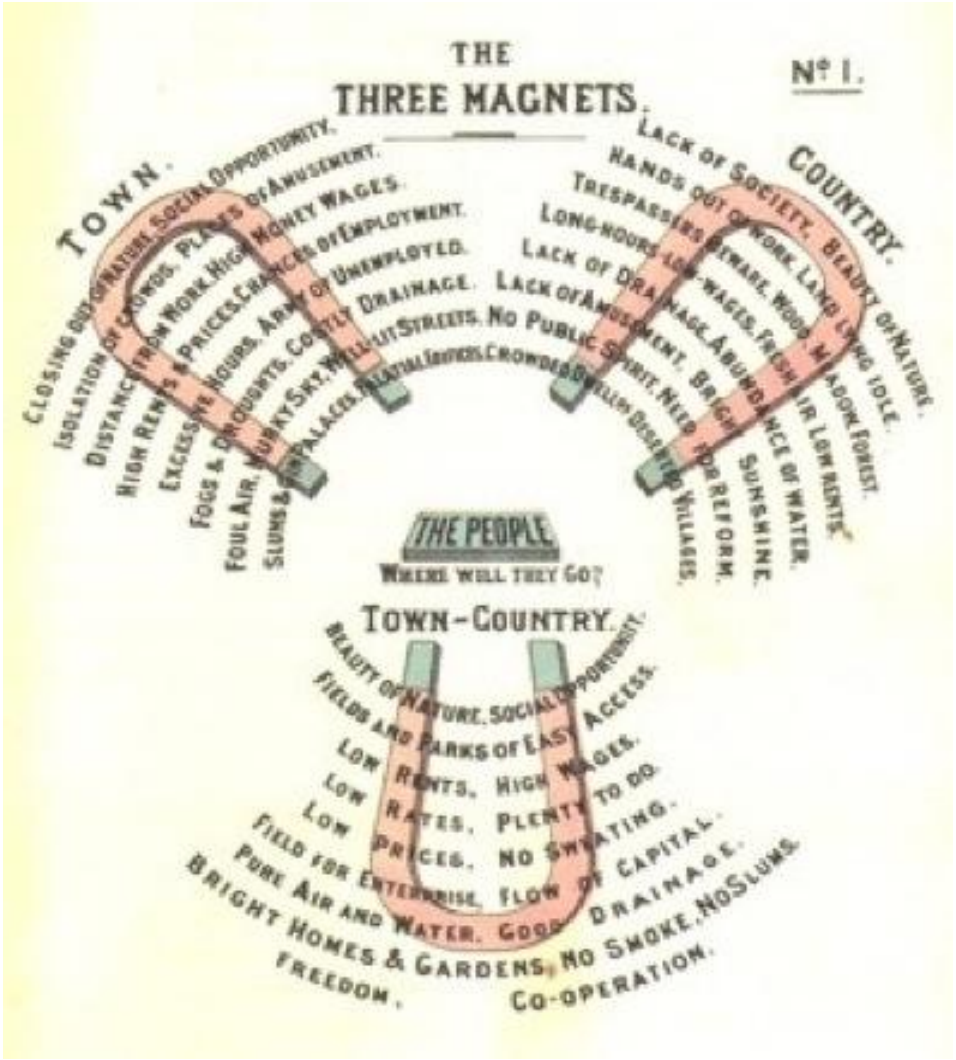


Figure 1 The three magnets of Ebenezer Howard and his solution to house the poor of London

From *Tomorrow, A Peaceful Path to Real Reform*

In the opening chapter of his book, Howard invites the reader to imagine the purchase of 6,000 acres of agricultural land somewhere near London, upon which would be built a new type of small city or town, called 'Garden City' to house a population of 32, 000 in the most possible of compact forms: a circular city with a radius of ¾ of a mile, a distance that could be traversed at a moderate walking pace in 15 minutes to enable pedestrians to reach even the remotest of destinations on foot in a reasonable span of time[xxiii]. The purchase, to be financed by public subscription in the form of debentures[xxiv], was to be managed by four trustworthy individuals who would hold the funds in trust for the purchase of a rural site suitable for the development and maintenance of a small city that, ultimately, would be held in common by the community[xxv]. Ground rents, collected by leasing plots of land to erect houses, factories, shops and to create farms that, along with other sundry assessments, subsumed under the heading of "rates",[xxvi]would be used to pay the interest due on the debentures, to carry out capital improvements, to fund municipal

maintenance costs and to create a sinking fund to redeem the debentures which would, in due course, be reduced to zero.

Recruited from the London slums, workers of the future garden city could expect to obtain employment and to live in a healthier environment. Manufacturers, co-operatives, professionals, builders and mechanics, solicited largely from light industries and artisan occupations could expect their businesses to profit from direct links, via railway, to suppliers and customers in nearby large urban centres while erstwhile farmers would again work the lands surrounding the future garden city with the expectation of a new market for their produce to be right at their doorsteps. In short "to raise the standard of health and comfort of all true workers of whatever trade-the means by which these objects are to be achieved being a healthy, natural, and economic combination of town and country life, and this on land owned by the municipality."[xxvii] To illustrate his ideas Howard describes his vision of his Garden City with such conviction and in such detail as to leave no doubt that he passionately believed in the merits of his proposed garden city and was convinced that it should be executed according to his plans and specification in terms of the physical form and socio-economic strategies [xxviii] described in his book.

> "Six magnificent boulevards – each 120 feet wide – traverse the city from centre to circumference, dividing it into six equal parts or wards. In the centre is a circular area of about five and a half acres, laid out as a beautiful and well-watered garden; and, surrounding this garden, each standing in its own ample grounds, are the larger public buildings – town hall, principal concert and lecture hall, theatre, library, museum, picture - gallery, and hospital. The rest of the large space is a public park, containing ample recreation grounds within very easy access to all the people.
>
> Running all around the Central Park (except where it is intercepted by the boulevards) is a wide glass arcade called the "Crystal Palace".[xxix] This building is in wet weather one of the favourite resorts of the people, whilst the knowledge of its bright shelter is ever close at hand tempts people into Central Park, even in the most doubtful of weathers. Here manufactured goods are exposed for sale, and here most of that class of shopping which requires the joy of deliberation and selection is done. The space enclosed by the Crystal Palace is, however, a good deal larger than is required for these purposes, and a considerable part is used as a Winter Garden – the whole forming a permanent exhibition of a most attractive character, whilst its circular form brings it near to every dweller in the town – the furthest removed inhabitant being within 600 yards.
>
> Passing out of the Crystal Palace on our way to the outer ring of the town we cross Fifth Avenue – lined as are all the roads of the town, with trees – fronting which, and looking on to the Crystal Palace, we find a ring of very excellently-built houses, each standing on its own ample grounds; and as we continue our walk, we observe that the houses are for the most part built either in concentric rings, facing the various Avenues (as the circular roads are termed), or fronting the boulevards and roads, which all converge to the centre of the town. Asking the friend who accompanies us on our journey what the population of this little city may be, we are told about 30,000, and that there are in the town 5,500 building lots of an average size of 20 feet by 130 feet – the minimum space allotted for the purpose being 15 by 125. Noticing the very varied architecture and design which the houses and group of

houses display – some having common gardens and co-operative kitchens – we learn that general observance of street line or harmonious departure from it are the chief points as to house-building over which the municipal exercise control, for, though proper sanitary arrangements are strictly enforced, the fullest measure of individual taste and preference is encouraged.

Walking still toward the outskirts of the town, we come upon the "Grand Avenue". This avenue is fully entitled to the name it bears, for it is 420 feet wide and forming a belt of green upwards of three miles long, divides that part of the town which lies outside Central Park into two belts. It really constitutes an additional park of 115 acres – a park that is within 240 yards of the furthest removed inhabitant. In this avenue six sites, each of four acres, are reserved for public schools and their surrounding play-grounds and gardens, while other sites are reserved for churches of any denomination which the religious feelings of the people may select, and which they are prepared out of their funds to erect and maintain. We observe that the houses fronting on Grand Avenue have departed (at least in one of the wards – that of which Diagram 3 is a representation) – from the general plan of concentric rings, and, in order to ensure a longer line of frontage on Grand Avenue, are arranged in crescents – thus also to the open eye yet further enlarging the already splendid width of Grand Avenue.

In the outer ring of the town are factories, warehouses, dairies, markets, coal yards, timber yards, etc., all fronting on the circle railway, which encompasses the whole town and which has sidings connecting it with a main line of railway which passes through the estate. This arrangement enables goods to be loaded direct into trucks[xxx] from warehouses and workshops, and so sent by railway to distant markets, or taken direct from the trucks into the warehouses or factories, thus not only effecting a very great saving in regard to packing and cartage, and reducing to a minimum loss from breakage, but also, by reducing the traffic on the roads of the town lessening to a very marked extent the cost of their maintenance. Each warehouse and factory has practically a goods station at its door, while no inhabitant of the city is no more than 660 yards from the railway, which is, of course, used for passengers as well as for goods. The depth of these lots fronting on the railway is 150 feet, and it will be seen that, besides their railway frontage, they front on a road (First Avenue), which is 90 feet in width.

All the sewage and other refuse of the town is utilized on the agricultural portions of the estate which is held by various individuals in large farms, small holdings, allotments, cow pastures, etc., the natural competition of these various methods of agricultural, tested by the willingness of occupiers to offset the highest rent to the municipality, tending to bring about the best system of husbandry, or, what is more probable, the best systems adapted for various purposes. Thus it is easily conceivable that it may prove advantageous to grow wheat in very large fields, involving united action under a capitalist farmer, or by a body of co-operators; while the cultivation of vegetables, fruits, and flowers, which requires closer and more personal care, and more of the artistic and inventive faculty, may possibly be best dealt with by individuals or by small groups of individuals having a common belief in the efficacy and value of certain dressings, methods of culture, or artificial or natural surroundings.

This plan, or, if the reader be pleased to term it, this absence of plan, avoids the dangers of stagnation, or dead level, and, though encouraging individual initiative, permits of the fullest co-operation, while the

> increased rents which follow from this form of competition are common or municipal property, and by far the larger part of them are expended in permanent improvements, and in drainage and other works, which involve considerable outlay.
> While the town proper, with its population engaged in various trades, callings, and professions, and with a store or depot in each ward, offers the most natural market to the people engaged on the agricultural estates, inasmuch as to the extent to which the townspeople demand their produce they escape altogether any railway rates and charges; yet the farmers and others are not by any means limited to the town as their only market, but have the fullest right to dispose of their produce to whomsoever they please. Here, as in every feature of the experiment, it will be seen that it is not the area of rights which is contested, but the area of choice which is enlarged.
> This area of freedom holds good with respect to manufacturers and others who are invited to establish themselves in the town. These manage their affairs in their own way, subject, of course, to the general law of the land, and subject to the provisions of sufficient space for workmen, and reasonable [xxxi]sanitary conditions. Even in regard to such matters as water, lighting and telephonic communication, -- which the municipality would, if efficient and honest, be certainly the best and most natural body to supply, -- no rigid or absolute monopoly is sought; and if any private corporation or any body of individuals proved itself capable of supplying on more advantageous terms, either the whole town or a section of it, with these or any other commodities the supply of which was taken up by the corporation, this would be allowed. No really sound system of action is in more need of artificial support than is any sound system of thought. The area of municipal and corporate is probably destined to be become greatly enlarged; but, if it to be so, it will be because the people possess faith in such actions, and that faith can be best shown by a wide extension of the area of freedom."[xxxii]

Accompanying the description of his vision for his Garden City, Howard prepared carefully executed drawings consisting of; a plan, drawn to scale, of a complete Garden City, with a population of 32,000, clearly showing circulation routes, the disposition of significant features and zones; a detailed plan, also to scale, of a ward or neighbourhood showing such details as locating, by name, the hierarchal road system and principal elements of the city [xxxiii] and a diagram of a regional plan depicting a ring of Garden Cities encircling an existing central city to create what Howard defined as a Social City. What most distinguished his drawings was the novel city plan: a circular city.

The assumption by many that Howard's design for his planned Garden City, by virtue of its circular shape, was merely a diagrammatic device conveying no specific information other than connections and functions leaving the final plan open to modification by others, are contradicted by the obviously laborious attention to detail, particularly in Figures 2 and 3, that far exceed that needed to generate mere diagrams. The detailed textual descriptions and the various features of the equally detailed plans by Howard, each drawn to scale in concert with a calibrated reference scale, and key dimensions noted in the accompanying text; the attention to descriptions of various aspects of his design such as the glass mall for shopping and social gathering; the spacious encircling broad avenues to provide spacious vistas of the to provide spacious vistas of the urban landscape;

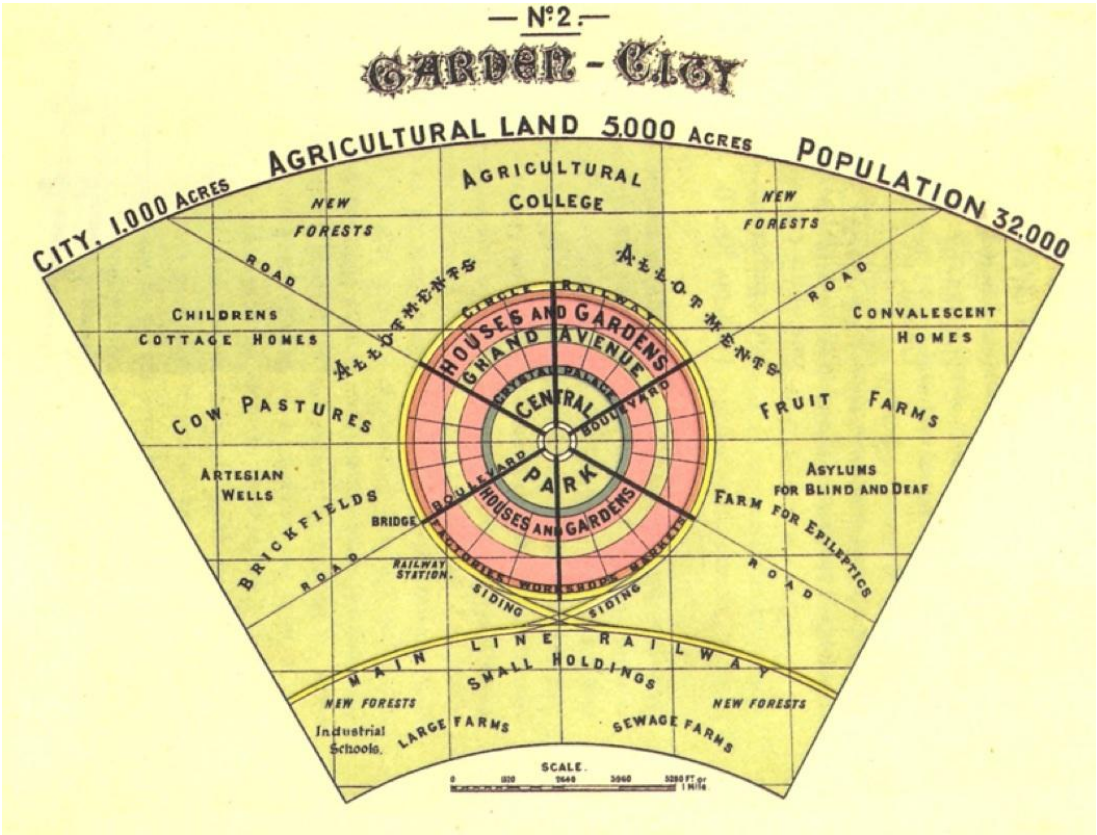


Figure 2 Ebenezer Howard's plan of his Garden City that is unmistakably circular.

From *Tomorrow, A Peaceful Path to Real Reform*

A common to provide space for personal and communal activities; the clean air provided by the surrounding agricultural lands; the short distance between all activities that, by virtue of the circular plan of the city, would enable residents to easily reach their destinations on foot; the rigid zoning and density strategy that divided his circular plan into clearly defined zones beginning with agriculture as the outermost band and progressing through industrial to residential, then to commercial, then to institutional, to finally culminate in an innermost circle of communal and social activities, the whole gathered together by a railroad siding that circumvented the industrial ring to directly service the movement of raw materials and manufactured goods and passengers [xxxiv] while, at the same time, controlling urban expansion with, quite literally, a ring of steel.

Despite Howard's diffidence in putting forth his concept for a Garden City, his personal conviction of the appropriateness of his design to reach his goal is manifestly clear. This assertion, reinforced by the quality and level of textual and graphic presentation in his book is at least equal to that of the 'schematic' level nominally considered, in architecture and urban design, to be the first stage of the design for an actual building or an urban development. As in all such schematic level designs, modifications are allowed to meet site and program requirements.

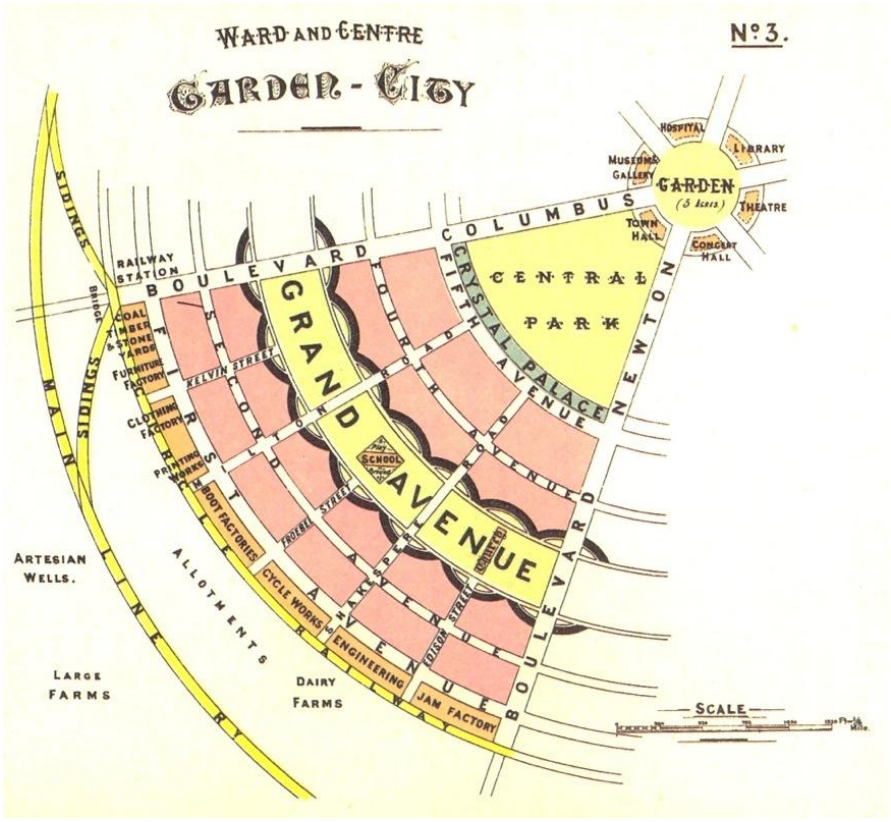


Figure 3. **Further details are revealed in this rendering by Ebenezer Howard of a Neighborhood.**

From *Tomorrow, A Peaceful Path to Real Reform*

Howard recognized this, hence his acknowledgement that his design could be subject to modifications but not, as transpired, so radically as to completely erase any trace of his original design[xxxv].

Howard's methods, unhindered by the cultural and aesthetic trappings of his age, led him on a path that, it now appears, pointed toward a future his fellow countrymen were unwilling or unable to follow. Recognizing his lack of creditability in the fields of architecture, planning, sociology and finance, he was forced to yield to the arguments of his professional or more experienced peers. They, for their part, steeped in the conventional wisdom, culture and tastes of their day, chose to follow the conservative path of proven experience, had looked backward over their shoulders to the past for inspiration, Howard had looked forward to the future for his.

The Unwin and Parker Model

Upon successful completion of the fund raising phase, a site was purchased and the public was informed that a prototype Garden City would be built. The First Garden City Limited was created to oversee the design and development of the prototype garden city that was to be named Letchworth. This task was entrusted, by the First Garden City Limited, to architects Raymond Unwin and Barry Parker, both of who were strong advocates of the conservative Arts and Crafts movement of the day. With this background it is not surprising that "When Messrs. Unwin and Parker came to design Letchworth itself,

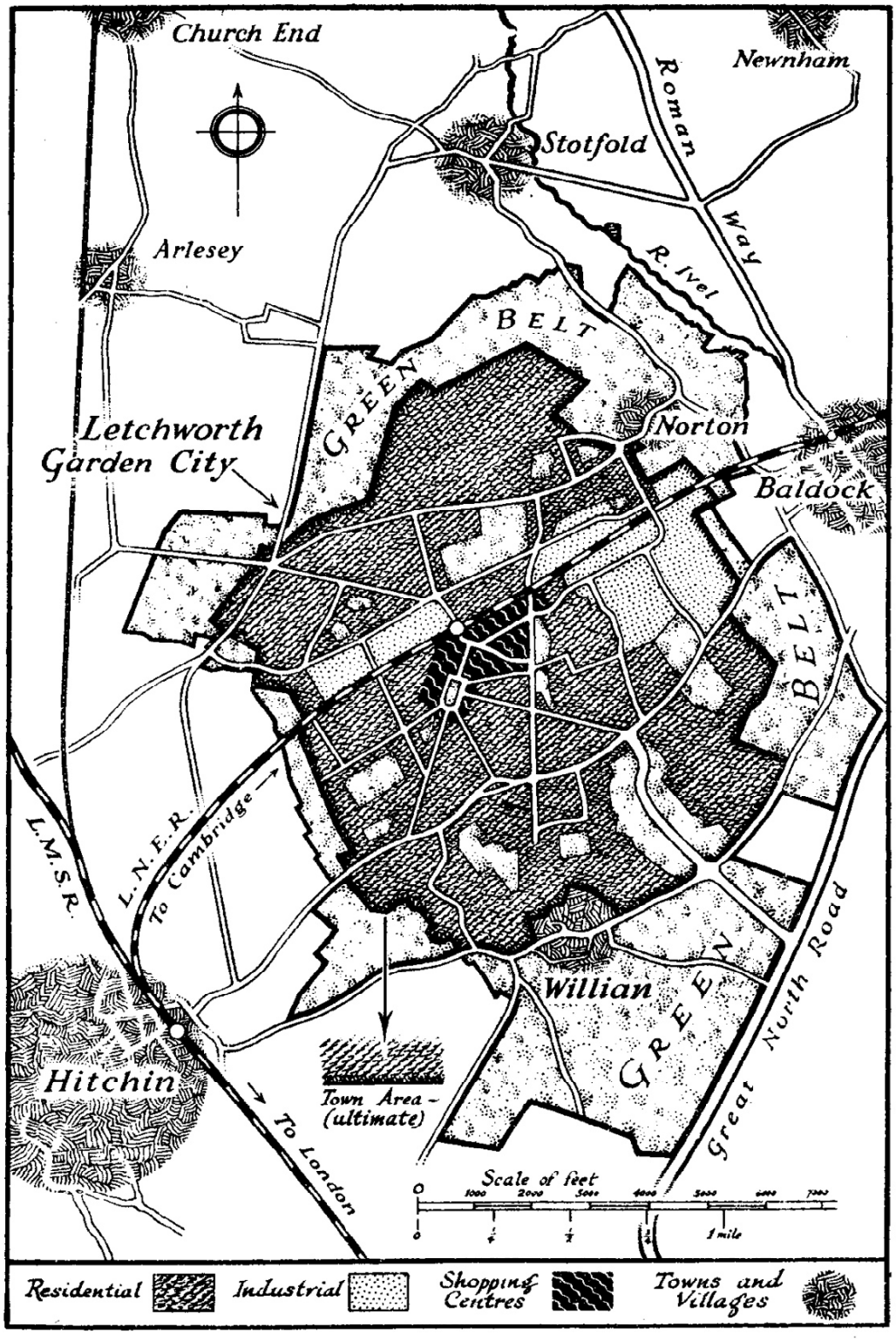
they perhaps leaned over backwards, in their effort to avoid mechanical stereotypes, in order not to duplicate Howard's diagrammatic city. Unwin's love for the rambling layout of medieval German hill towns was even in some degree at war with Howard's rational clarifications and forward-looking proposals." [xxxvi]

In spite of the fact that " Howard also makes it clear that Garden City is to be consciously planned. There is to be an overall plan, along the lines already suggested in Diagrams No. 2 and 3 – modified, as he [Howard] is at pains to state, to fit local geography" [xxxvii]. Unwin and Parker ignored this admonishment. Letchworth thus built, was not the Garden City in Howard's publication, but the creation of Unwin and Parker. This distinction, blurred over time and rarely noted, associates Letchworth with Howard's publication, *Garden Cities of Tomorrow*, thereby relegating his published plans to the status of mere 'diagrams' which they are not. In retrospect, it appears that the consequences of the decision of Unwin and Parker to create their own version of a Garden City, set Europe, North America and ultimately, the rest of the westernized part of the world, on a path that diverged widely from that advocated by Ebenezer Howard. The character of human settlements, the quality of life therein and their relation to the natural environment was determined by the design of Unwin and Parker, the consequences of which are only now becoming fully apparent.

While Howard freely acknowledged that the inspiration for his social, economic and built environment proposals were garnered from many sources, his contribution and claim to originality lay in their combination to make his proposals practical and realizable, thus separating his from similar but more utopian proposals of his peers and [xxxviii]predecessors. This observation was not shared by all: in the plethora of books and articles following the completion of Letchworth, and up to the present, successive generations of experts in city and regional planning have concurred that Howard's urban and regional design proposals were merely diagrams.

Among the more emphatic of these was C. B. Purdom, a former assistant to Howard, who[xxxix] observed, in the 1946 edition of *Garden Cities of Tomorrow*, of which he was the editor and to which he contributed a lengthy Forward, "As might be expected, many people took the proposal as a mild joke; the diagrams of a circular city divided into areas by broad avenues rather like the spokes of a wheel aroused particular interest and even amusement….". [xl] Page 51 of the 1946 edition also included a warning, with no attribution, in the form of appended text in italics that states " *a description which is, however, merely suggestive and will be probably much departed from*". Other, more blatant overwritten insertions, crudely scrawled in capital letters, with a broad stroke pen across the faces of Figures 2 and 3, " A DIAGRAM ONLY- PLAN MUST DEPEND UPON SITE SELECTED ". It is possible that these assertions were the work of Purdom, who obviously did not, as did most of his countrymen, consider the circular plan of Howard to be anything more than a diagram.

Mention of the physical aspects of Howard's proposal has been rare. Discussion instead focused on mythical versions of his adapted social and economic strategies, ignoring the imaginative scope of the carefully drawn plans and painstakingly detailed written observations. Public reaction to the design and



PLAN OF LETCHWORTH

Figure 4 The Garden City of Unwin and Parker
From Professor Simon Atkinson's Urban Design Theory Seminar Web Page, University of Texas

description of the circular city were largely negative or simply dismissed as diagrams. Not a surprising conclusion considering that Howard's design for a circular city was submitted in the waning days of the Victorian era; an extremely conservative period, particularly in social, financial and aesthetic terms. A circular city, based on mildly socialist economics, would likely be rejected by a rigid class-driven society on the grounds of non-conformity.[xli]

The irony of this outcome lies in the failure of any of Howard's proposals to be realized leaving his Garden City not built; his goal to achieve community based land ownership abrogated by an externally installed conservative management[xlii] to satisfy the demand for individual plot ownership; the relocation of working class poor from London was, in part, preempted by enthusiastic middle class dilettantes who usurped the housing lots intended for the working class poor from London, thereby changing the character of Letchworth to that of an urbane middle class community that survives up to the present; and finally to have a compact, fully zoned, pedestrian and focused community was thwarted by the decision of Unwin and Parker to completely re-arrange or discard all elements of Howard's plan and to upgrade the original compact worker's housing to larger free standing houses on individual plots thus extending the town boundaries beyond practical pedestrian travel. The irony is further compounded when it becomes apparent that the Unwin and Parker version became, ipso facto, the Garden City upon which all succeeding Garden Cities, or the parts thereof are based, while Howard's original plan languished within his book.

The very few examples of Garden Cities that follow the Letchworth prototype of Unwin and Parker, built in Europe and North America, suggest that the Unwin and Parker concept of Garden Cities failed to reach the goal Howard had hoped to achieve: benign environments with a secure, equitable and wholesome quality of life for the working class.[xliii]

Following the completion of Letchworth, numerous non-professional groups, and commercial organizations, in Britain, Europe, and America, came into existence to introduce or to attempt to build their copy of Letchworth, the Garden City of Architects Unwin, and Parker. Amongst professional town planners, particularly those in United Kingdom and the United States, established regular communications and frequent visits to advance Letchworth as a model for the future of housing in their respective countries. Generations of town planners in America led in attempts to emulate reproductions of the Unwin and Parker design of Garden City. Today, they continue to do so, now under the banner of New Urbanists. None of their many attempts were fully successful and the dream of Ebenezer Howard to see his Garden and Social Cities broadcast around the world died along with their inventor.

The 20th Century Conurbation Model

At the close of the 20th Century the world had little to show in the way that human management had benefited the planet. The advent of the conurbation, which describes nothing more than the merging of incremental sub-urban expansions of neighboring cities and towns into continuous urban concentrations can be a difficult, unpleasant and depressing environment in which to live and, in the case of those located in many developing countries, often life threatening. Facilitating this phenomena were amorphous subdivisions whose design origins can be traced back to Letchworth, the Garden City of Unwin and

Parker[xliv] that, unlike the Garden City of Howard, with its strict population and density control, strong geometric configuration and edict of discrete dispersion, are the antithesis of the sprawling suburbs of the conurbation.

The ultimate morphology of conurbations and how well they fit into the environmental, social and political landscapes of the 21st century remain unclear. Will they continue to grow until they finally implode in their own clogged density, waste and successive layers of infrastructural palliatives or, will the massive expenditures that will be wasted in futile attempts to rescue conurbations from their present dire circumstances, be redirected toward building new more humane and efficient cities? If the goal of conurbations has been aggrandizement, it has overshot its goal by a very wide margin. It is time now to stop, to look back, to learn from past mistakes and to set reasonable and realizable goals before the edge of the abyss of unknown consequences, is reached.

Looking forward to the 21st Century holds no promise for a better quality of life than that of the tumultuous Twentieth Century. On the contrary scientists warn of increasing disasters such as flooding and storm surges to increase in magnitude, intensity and frequency, of even further degradation of climate and bio-diversity as a result of global warming that may trigger coastal inundations, an increase in the number and intensity of tornados, hurricanes or typhoons, a change in rainfall patterns that could affect harvests and the supply of potable water and of the onslaught of hitherto unknown incurable pandemic diseases.

Politicians warn us to expect terrorism, ongoing revolts, revolutions, clashes or wars among autocracies, theocracies and democracies, a return to the struggle for world hegemony and a renewal of destruction and death by nuclear devices. If these predictions are even partially correct, we can expect shortages of food and water, floods, radioactive deposits leading to large displacements and migrations of populations, and a reduction in the quality of life in ravaged cities and despoiled countrysides.

Demographers and geographers hint of volatile population growth among developing countries that may stress the limits of natural resources of the world. As supplies of critical natural resources, such as food, so necessary to sustain human life dwindle, riots and hostile acts by those struggling to survive will increase. Nations with planned populations who harbor their natural resources may survive but may become the targets of deprived populations seeking new lands with resources sufficient to assure their survival even at the expense of displacing their host nations. Surreptitious migrations already extend to an inter-continental scale, as small boatloads of migrants regularly cross the Mediterranean Sea from North Africa to the shores of Europe and South and Central Americans scale the walls that separate them from North America. Such migrants may swell, in the future to become mass invasions.[xlv] Events of this nature should stimulate plans for survival at the most basic levels of secure shelter, adequate food sources, education and medical support while still sustaining the existing level of flora and fauna bio-diversity. Security in the 21st century should provoke a review of human settlement patterns to assure a more defensible and secure future.

Momentous changes have occurred since the publication of *'Tomorrow, a Peaceful Path to Reform'* more than100 years ago, to raise the question: is the notion that people can benefit and prosper while living

in a sylvan environment no longer practicable or even desirable? Can a Garden City support the amenities that contemporary cities enjoy or make a substantial contribution to housing the worlds burgeoning population? Compared to conurbations, can garden cities better fulfill the promise of a healthier, fuller, and more prosperous life for their inhabitants? These questions need to be answered before the Garden City of Ebenezer Howard can respond positively to the conditions that would have to be addressed in so many different environments and in a different age.

Answers may lie with the strategy devised by Ebenezer Howard: adaptation of past and current technologies, cultures, commerce, trade, industry and husbandry to innovate, by their combination, an unique and appropriate solution by taking "… a leaf out of the books of each type of reformer and [binding] them together by a thread of practicability"[xlvi]. This strategy encourages solutions that are current today but that still adhere to Howard's principles in the text and drawings of his original unsullied publication of 1902 as a point of departure toward a truly universal future garden city.

Chapter III

21st Century Precepts

[take].. a leaf out of the books of each type of reformer and [bind] them together by a thread of practicability. Ebenezer Howard, 1898

In his book, *Tomorrow: a Peaceful Path to Real Reform*, first published in the 19th century, Ebenezer Howard had expressed a set of preconditions consisting of precepts, processes and principles, derived from many sources, for the design, finance, implementation, management and quality of life in his Garden City that remain as relevant today as they were 100 years ago. Around this core are wrapped additional interdependent precepts, processes and principles to account for a radically evolving 21st century and to provide the tools needed for Garden Cities to be adaptable; in size, from hamlet to city; in terms of sophistication, amenities and technology from the lowest tier of developing countries to the most mature of industrialized nations; and in terms of existing environmental, cultural, religious, political and economic contexts, to be the most amenable. From these old and new precepts will emerge Garden Regions in which Garden Settlements, with functions and forms yet to be imagined, can flourish in the 21st century.

Gravity Neutral Garden Settlements and Regions

The precept of Gravity Neutral was widely practiced in the 20th century with the aid of mammoth bulldozers who routinely flattened vast swathes of natural terrain into tabletop level acreages for subdivisions or gouged deep cuts through steep hills to make straight and level highways. Gravity Neutral Garden Regions and Settlements would underlie all future precepts to determine minimal disturbance to the natural environment of all physical forms and locations of future Garden Settlements. Based on an agricultural technique prevalent among ancient cultures in remote[xlvii] mountainous regions and still practiced up to the present, are terraced hillsides of agricultural plots distinguished by their stacked stone retaining walls that, like giant steps, ascend steep hillsides to stabilize the topsoil. One of the distinctive features of many primitive stone retaining walls is their level top. The purpose of this exactitude is to ensure that rainfall and irrigation water will be evenly distributed for the entire length of each terraced plot. Engineers and surveyors similarly show on their plans lines that maintain, as do the tops of the stone retaining walls, the same level that, when viewed from above (a plan view), weave across the face of ridges and valleys. Following any single line, called a contour line, would provide, as do the tops of level stone retaining walls, the guide to maintaining a level pathway.

The application of this precept to Garden Settlements and Regions yields benefits to both wheeled vehicles and pedestrians, especially for vehicles traveling across regions and pedestrians walking long distances. Savings accrue in human energy and fuel consumption[xlviii] when compared to conventional road systems that follow directionally determined routes that traverse, rather than follow contour lines, to ascend and descend hills. The same precept also may be applied to liquids in piping that, if made to follow a single level contour line, can provide the benefit of a storage vessel as well as a conveyor of liquids with uniform pressures through their entire length. [xlix]

The Circular Settlement Redefined

The antecedent, acknowledged by Howard, for his circular city plan was the square city plan of Buckingham[l] a transformation that, apart from the conventional wisdom that his plans were only circularly shaped diagrams, raises the intriguing question that has never been fully explained: what influences prevailed upon Howard to modify the Buckingham square plan to the circular configuration of his Garden City plan? A possible explanation for this radical change is the obvious awkwardness of circulation paths, particularly at the corners or intersections of radiating and right angle roads of the Buckingham plan: a shortcoming that is easily corrected by transformation to a circular plan in which both radiating and circular street pattern intersect tangentially at 90 degrees to create fluid, navigated corners of all circulation paths[li].

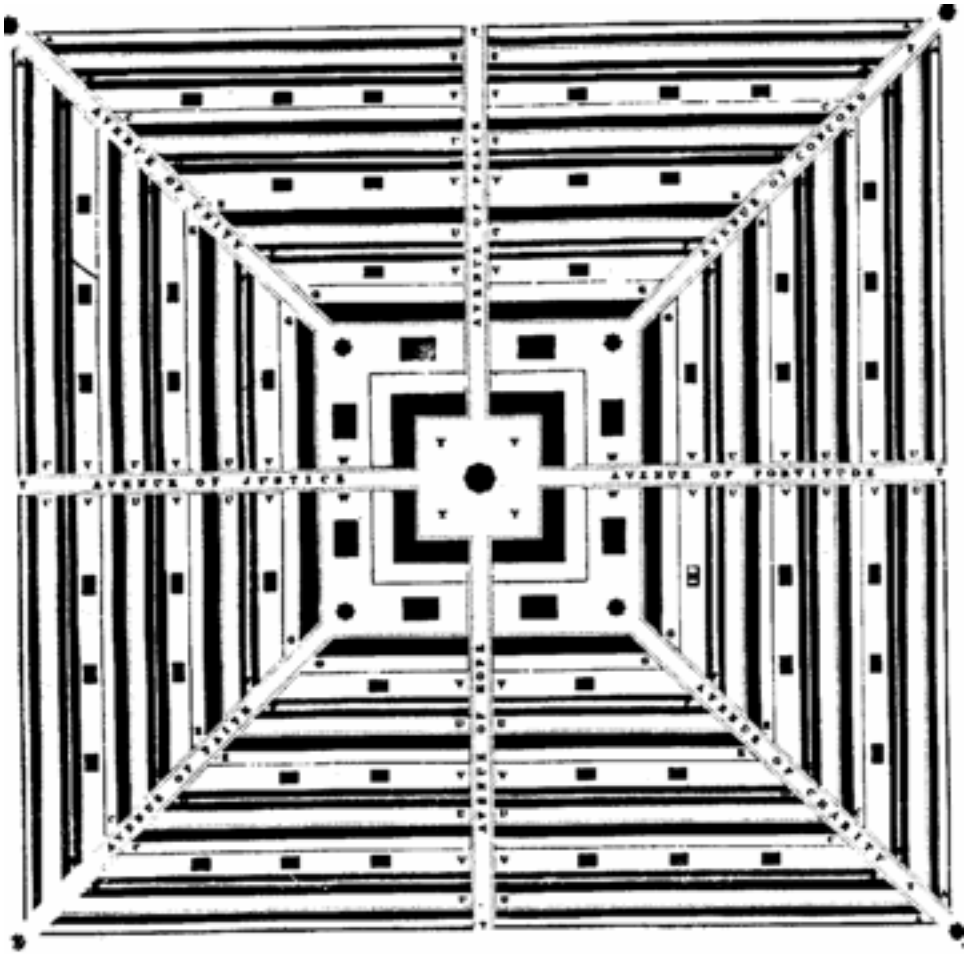


Figure 5 The City Plan of James S. Buckingham
From the Web Site of Professor Emeritus John W. Reps, Cornell University

Other, more substantive examples of circular human settlements with both historical and current models, are medieval villages found throughout Europe and the British Isles, in parts of Africa and Asia that, when arranged in a circle, enclose a common area in the centre to provide a secure place to hold livestock, to grow garden produce and to hold communal festivities and recreational activities. In the same vernacular, a significant primitive circular settlement[lii] was the African Zulu Kraal, whose origin preceded, by many centuries, the publishing of Howard's circular Garden City. Distinguished by a strict geometry

consisting of concentric bands of dwellings, arranged in hierarchal order with the highest caste closest to the central compound of the king in the centre to the lowest caste in the outermost band next to the wood stockade that encircled the krall, is strikingly similar to Howard's Garden City in plan form and function. Press coverage of the Zulu Wars, being waged at the time Howard was preparing his book for publication, could have contained drawings or written descriptions of the Zulu Krall, that may have come to his attention. In the 20th century proposals for circular cities, including that of Ebenezer Howard, reappeared but were deemed, by English Victorians, to be merely fanciful dreams.

Howard's reason for choosing a circular configuration however, may lie instead, in his logical and rational approach to the design of his Garden City. A more careful scrutiny of Howard's scaled drawings with their calculations and conclusions, reveal a solidly based, fully pragmatic argument for the adoption of a circular city plan. As the most efficient shape for a fixed area of land and specific population density, the circle has no equal. For a pedestrian based community, the circle, with its shorter continuous distance between boundaries and with no acutely angled intersections to obstruct traffic flow, enable a continuous circular and radial flow of goods, services and people and an efficient arrangement for zoning of work, shop, home and recreational spaces.

Purely geometric circular cities, however, can only be placed on flat building sites that are found mostly in river deltas, on prairies and steppes, some desert areas and, less frequently, where upright or inverted bowl shaped sites may be found. Other settlement sites might have irregular terrain where, were a geometric circular settlement plan to be placed upon it, would be distorted by hillocks and depressions to yield irregular boundaries and detours around peripheral obstructions. This would change the plan to a set of linked curvilinear lines to create a closed loop. The distortions to pure geometry might benefit the settlement design by incorporating naturally derived features to impart an organic quality to the geometry of a pure circle to thus reinforce the integration of the settlement with its site.

For Garden Settlements based on the Gravity Neutral concept, when following a single contour line to maintain a completely level settlement circulation system, could change the configuration of a settlement, to be transformed into a closed loop of arcs that, by closely following the existing terrain could create a perfect marriage of site and settlement. Utilities that follow the Gravity Neutral path would utilize a closed loop distribution system to maintain a uniform level of distribution pressure or collection throughout the enclosing loop so that, in the case of a malfunction at some point in a loop, would close down only the point where the malfunction occurred, leaving distribution or collection in the rest of the loop unaffected

Bundling Utilities and Services

Partly because of historical antecedents, bureaucratic factionalism and laissez-faire policies, utilities such as electricity, various communication media, water and sewage systems, and various methods to transport goods and passengers, were implemented by various institutions, groups or individuals, in various locales at various times. The resulting chaotic assemblies of overhead wires, buried pipes, steel rails, roads and expressways that crisscross each other en route to reach or join together conurbations, cities and towns and unique needs such as rural electrification, huge mining and manufacturing complexes and utility hubs

in remote locations. Implementing and maintaining utilities and services singly, has proved to be costly, often redundant, and ultimately inefficient and would be extremely costly to re-engineer.

Common carriers and strategic points of distribution to reduce redundancy and costs is a most obvious solution but too difficult to introduce because, as conventional wisdom suggests, unraveling the multiplicity and complexity of private and public interests is too formidable to execute. Instead utilities and services are continuously being overlaid by new installations resulting in ever-taller utility poles and multiples of thicker wires and more elevated or tunneled raceways all of which are costly and contribute to a further reduction to the quality of human environments.

An opportunity to rework or replace the complexity of current systems to a more simple and rational system that respects the natural environment and the quality of human life lies with the introduction of Garden Regions and Settlements. With their adherence to the principle of the closed circuits, limits to size, location and density fixed from the outset and with a clear understanding that the objective of utilities and services is to directly service their ultimate recipients which are human settlements, the routes for all utilities and services could be bundled together to follow common hierarchal paths from continental level, to Garden Regions, to Social Cities to terminate at each Garden Settlement as the hub from which to distribute utilities and services.

Connections, based on the continuity and flow of the closed loop or circle, at each level in the hierarchy is also provided so that loads can also be transferred horizontally among the Garden Settlements in a Social City[liii], among Social Cities in a Garden Region and among Garden Regions in a continental distribution system. Vertical and horizontal distribution along continuous paths assures ultimate flexibility in balancing utility and traffic loads and an end to the improvised networks of today that terminate in remote hubs with critical load points that frequently fail and are often remote from the cities and conurbations they serve making the flexibility of multiple alternate routes in the Corridor system that incorporates bundled utilities and services directly between human settlements is clearly superior. Moving large volumes of liquids between regions as is proposed by the China South to North trans-continental water line or oil in conventional elevated trans-national lines both of which require special pipe with mechanical pumps at every change in elevation might be handled by in situ Regional Corridors piping that could have multiples sizes, volumes and collection and distribution points at less cost.

Social Cities

Realizing that his Garden City, with its modest population of 32,000 could not hope to offer all the amenities offered by a metropolis, Howard proposed a cluster of linked Garden Cities he called a Social City. These congregations appeared in the first edition of *Tomorrow, A Peaceful Path to Real Reform* as a ‘Group of Slumless Smokeless Cities’ that could support such edifices as libraries, opera and ballet houses as well as national and international sporting events while maintaining the stricture of the finite populations of individual Garden Settlements. This would require congregating Garden Cities into closely connected groups,

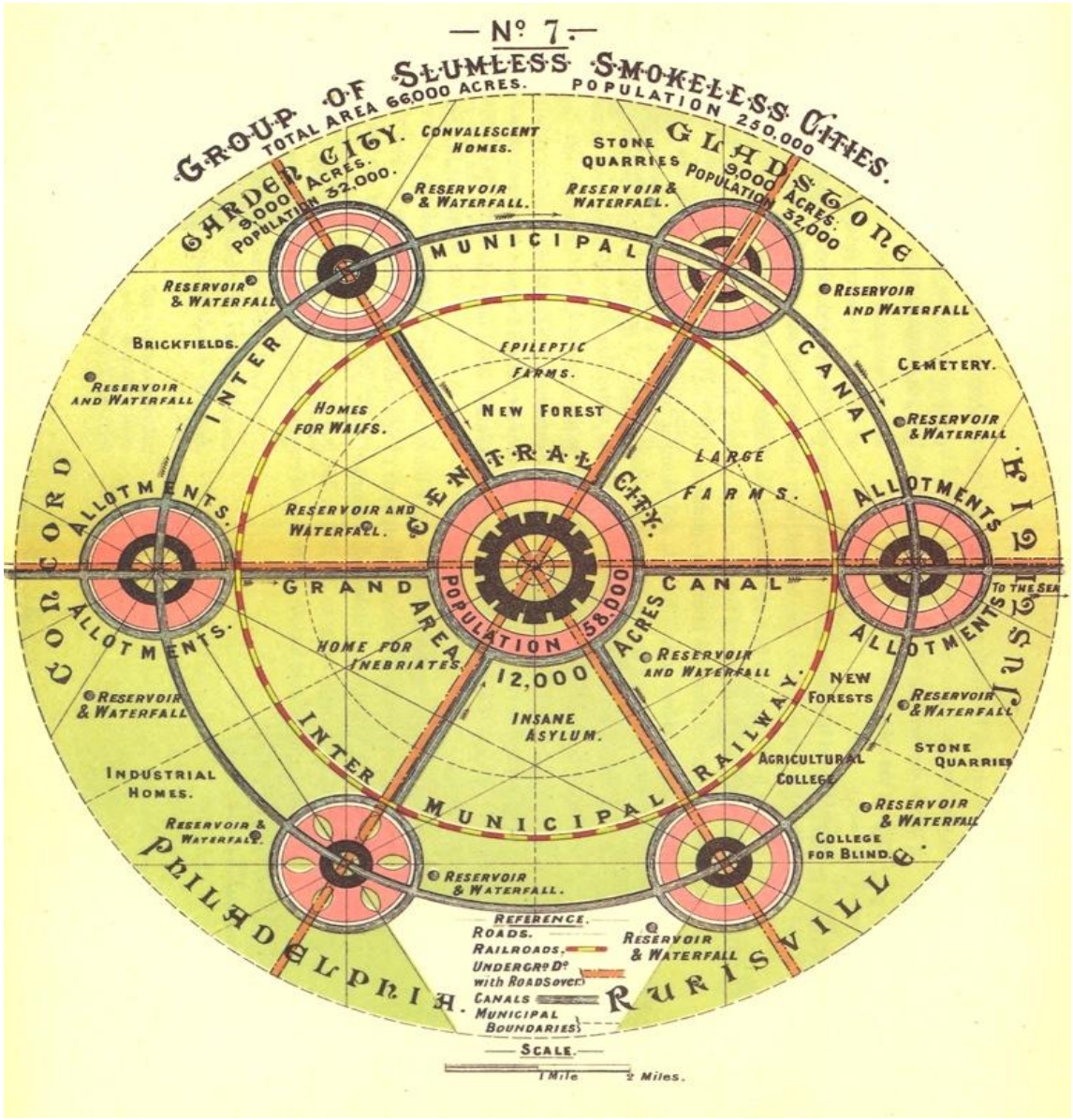


Figure 6. The reproduction of Social City proposed by Ebenezer Howard
From Tomorrow A Peaceful Path to Real Reform

A 21st century version of a Social City is reproduced in Figure 7. This version of 'Social Cities' would typically consist of f Garden Settlements nestled in a verdant valley through which might run a small river with a small lake. Each Garden Settlement, in this example, maintains its own isolated agricultural, preservation, 'Green' and 'Red' lands managed in the tradition of the Hawai'ian A'ha'a'pua.

Linked together in a close knit autonomous group, contact among the member Garden Settlements is only through an Inter-Urban Corridor and, via a Inter-Modal Node in the Garden City nearest to a Regional Corridor directly to regional, continental and world centers and markets. The Inter-urban Corridor would be a 2-speed model: a walk-on standing slow speed sidewalk between member Settlements and an express high speed seated model between member Settlements and the Inter-Modal Regional Node.

Figure 7 A Social City for the 21st Century

Extrapolattion from Tomorrow, A Peaceful Path to Real Reform, of structure and organization of the Social City of Ebenezer Howard

Achieving Sustainability, Security, and Autonomy

Given the potential disturbances and dangers that might disrupt global inter-dependencies, prudence suggests that, in times of emergencies Garden Settlements should be able to sustain themselves for indefinite periods. This requires that all resources and skills needed to acquire independence, such as an infinite potable and irrigation water supply, agricultural lands sufficient to indefinitely feed the community a fully balanced diet and the provision for self-sufficient and sustainable energy sources. These should incorporate a planning stage: identify the site (relocate or rebuild), organization (executive, technical, aid co-ordinator and labor), mobilization (victims to labor force) and implemented stage of every Garden Settlement. During quiescent times water, agriculture and energy resources of Garden Settlements could be incorporated into regional trade and energy networks to carry out commercial activities.

Energy Sources

Other than electrical energy drawn from remote sources and delivered through grids at a continental or provincial scale, the availability of sustainable local micro sources of energy suitable for small cities, towns, villages and hamlets has been limited to only a few sources. Presently only hydroelectric generators powered by nearby waterfalls, wind-powered generators of various configurations and solar powered photovoltaic cells can produce pollution free energy. These sources, however, are subject to the vagaries of nature, have no economical way to store surplus electrical energy and create sprawling "farms" of photovoltaic panels and towering windmills stretching across and marring the natural landscape.

Possible sources, still under development are compact micro-nuclear (that still lack a safe way of disposal of spent fuel rods) and hydrogen fuel-cell generators (that require a ready sources of hydrogen) are not dependent on natural energy sources and can operate continuously and indefinitely, are coming on line[liv]. A coterie of Garden Settlements so powered, could connect together via Regional Corridors to become a de facto electric grid and, by extrapolation, could create a hierarchic de facto grid among Garden Regions. This would eliminate the unsightly waist high surface mounted oil pipe lines and rows of steel towers and wood poles and wind farms resting on their expensive rights of way, with their heavy drooping cables, unending surface pipe lines and monumental towers and blades of wind farms that stretch across continents.

Water Resources

Water management is an increasingly important technique, as the population of the world increases and erratic and extreme weather patterns point to unpredictable floods and desiccation. Water, drawn from freshwater lakes, rivers, streams and springs and underground water retrieved by shallow or deep bored wells, may require treatment to be potable however, rainwater falling on clean roofs, is commonly considered potable. Treatment and storage to produce potable water must be included in Garden Settlement plans as insurance against unforeseen circumstances that can be recycled for non-potable purposes is essential and in areas with no or minimal rainfall, special means such as those of the Kibbutzim[lv] should be employed. To achieve autonomy and sustainability Garden Settlements will be compelled, especially in arid conditions, to devise novel methods such as condensation of nighttime air

borne moisture, to conserve and recycle water. In all cases Garden City, Regional and Inter-regional Corridors must be designed to convey large volumes of water to balance water distribution, on a demand basis, between regions experiencing floods or flooded to arid or desiccated conditions.

Chapter IV

The Anatomy of a 21st Century Garden Settlement

"Smaller ...cities can easily adopt appropriate and cheap technologies for water supply,waste disposal, transport and energy generation.
Asesh Kumaar Maitraa 1998

Garden Settlements in a Garden Region

Finding the correct location for Garden Settlements in Garden Regions is first determined by land use codes that stipulate that settlements are not allowed in agricultural or preservation lands or in locations that would obstruct natural features such as rivers or the migratory routes of animals and bird sanctuaries. The total sum of all Garden Settlement populations are required to not exceed the carrying capacity of their Garden Region in terms of the essentials necessary for a healthful, economical and societal existence. Garden Region administrations would determine the population limit in terms of what natural resources would fall within the purview of each Garden Settlement and what would be the labor required to develop these resources. Within this range, there will be found an optimal size and scale, that yields the most cost effective and simple infrastructure, the most responsive civic management, the most appropriate density ratio to yield the smallest settlement footprint and impact upon the natural environment. Finding this optimal size and shape will yield the right "fit" for each type and scale of Garden Settlement.

> "Smaller ...cities can easily adopt appropriate and cheap technologies for water supply, waste disposal, transport and energy generation. The majority of these technologies work best ...and thus are more suitable at small city scale [rather] than at conurbation scale. Conurbation scale needs complex and expensive technologies to solve the simple problems of drinking water, clean air, mobility, and communication. Small cities are inherently more sustainable because they are amenable to adoption of renewable technology for water supply and sanitation, energy production and need a low amount of mechanized transport and goods..."[lvi]

In the division of space for human use and for infrastructure, allocation for these two uses should be complementary. There should be no question of one or the other pre–empting the design of Garden Settlements. The human spirit is more complex than the most sophisticated of infrastructural systems and needs at least the same amount of attention in arranging spaces intended for human use as well as those for infrastructural needs. Figure 8, a plan of a 21st century circular Garden Settlement and its division into autonomous wards or neighborhoods, shows the equitable, functional and harmonious distribution of space

for productivity, movement of goods and people, commerce and leisure between human and infrastructural needs.

Garden Cities of the 21st Century

Figure 8

Plan of a Garden Settlement

An Extrapolation of the Garden City
of
Ebenezer Howard

Scale 1 foot : 12,000 feet

Outer Agricultural Zone

Regional Corridor

Regional Corridor Node

Inner Agricultural Zone

Range fed cattle

Pastures, grains and orchards

Outer Agricultural Zone

Dairy farming, Grazing ranges, Citizen plots (allotments)

Orgamiccaly grown edibles

Drip irrigated organically grown fresh market produce and stalls fot dispensing fresh fruits, dairy products and butchered meats

Residential Zone 3

Residential Zone 2

Residential Zone 1

Hospital, Schools, Markets, Shops, Food Services, Offices, Library, Fire Station, City Hall, Police, Fire Station

Two storey housing

Three storey housing

Four storey housing

Garden City Typical Node

Residential Zone 4

One storey housing

The Circular Mall

Fifth Avenue

Fourth Avenue

Grand (Third) Avenue

Second Avenue

First Avenue

Service Zone Warehousing, light industries, parking stalls for visitors, residents and bays for commercial vehicles with internal combustion engines

Perimeter Road

The Common

Sports Recreational Facilities
and Social and Respite Areas.

Scale 1' : 10,000'

A Doctorate Project by A. Bruce Etherington, Spring Semester, 2012, Committee Chair Joyce Noe

Garden Cities of the 21st Century

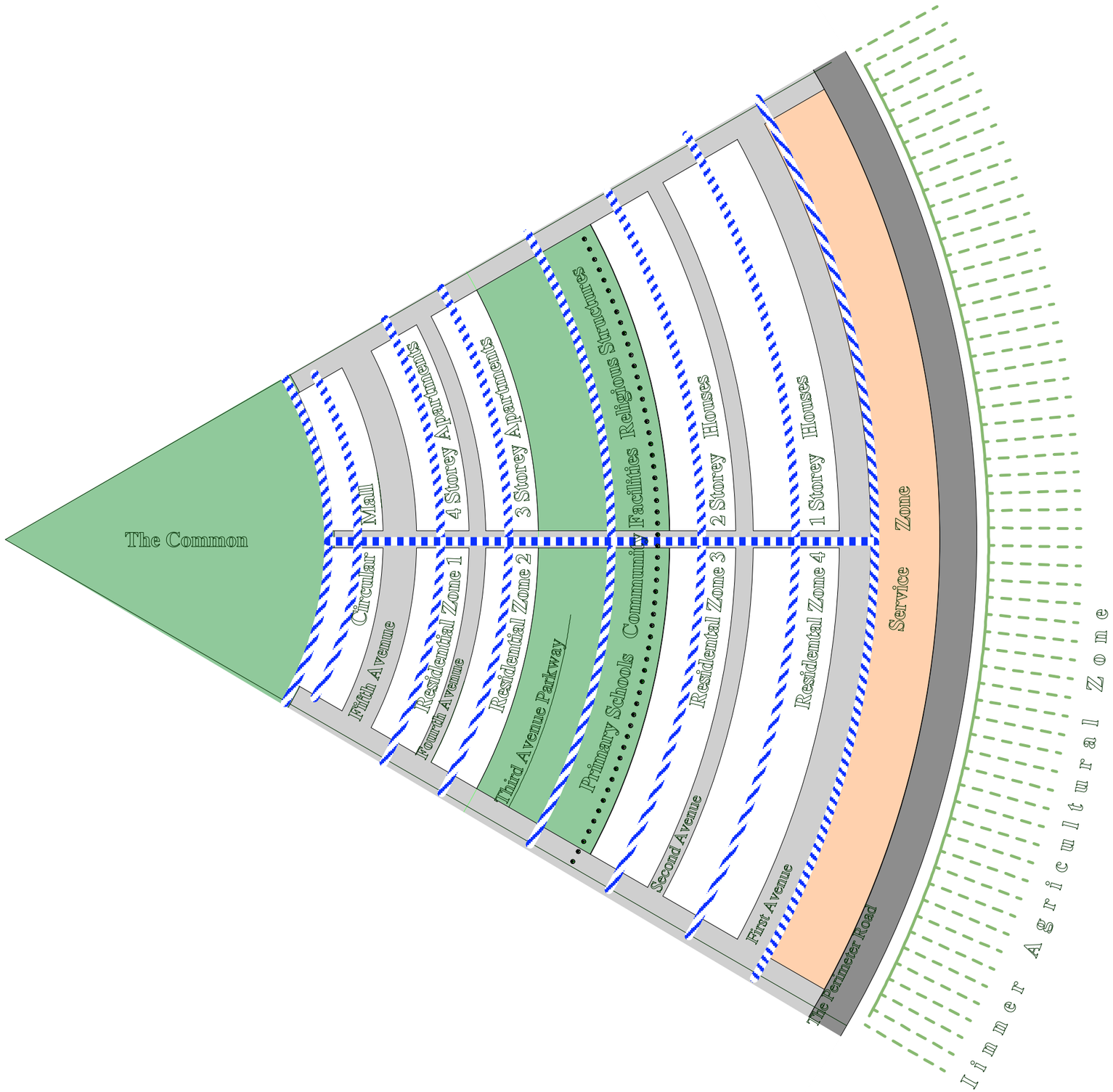
Figure 9

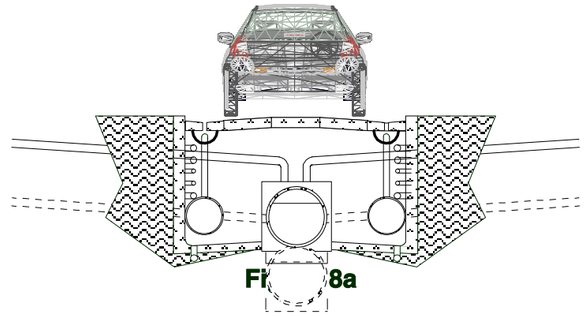
Plan of a Garden Neighborhood

(Including Details of Urban Corridors not to scale)

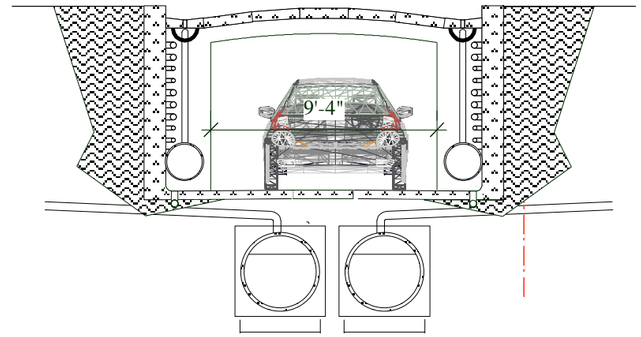
An Extrapolation of the Garden Ward
of
Ebenezer Howard

Scale 1 foot : 12,000 feet

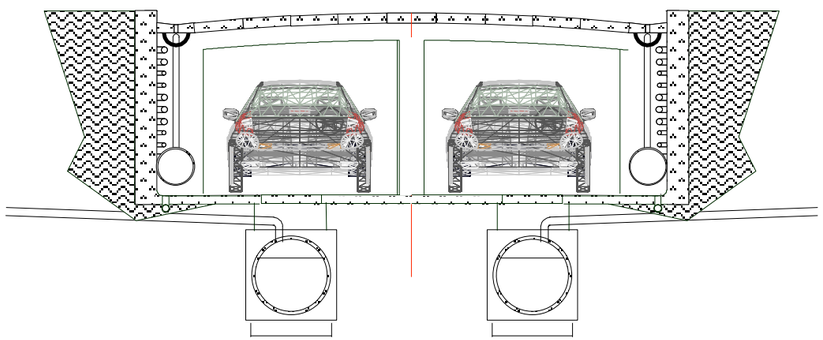




Basic Urban Corridor Type 9a



To Surge Tanks Corridor Type 9b



Circle Shuttle Urban Corridor Type 9c

Scale 1' : 12,000'

0' 100' 200' 400' 600' 800' 1000'

Garden Cities of the 21st Century

Figure 10

Cross Section of ½ of a Garden Settlement

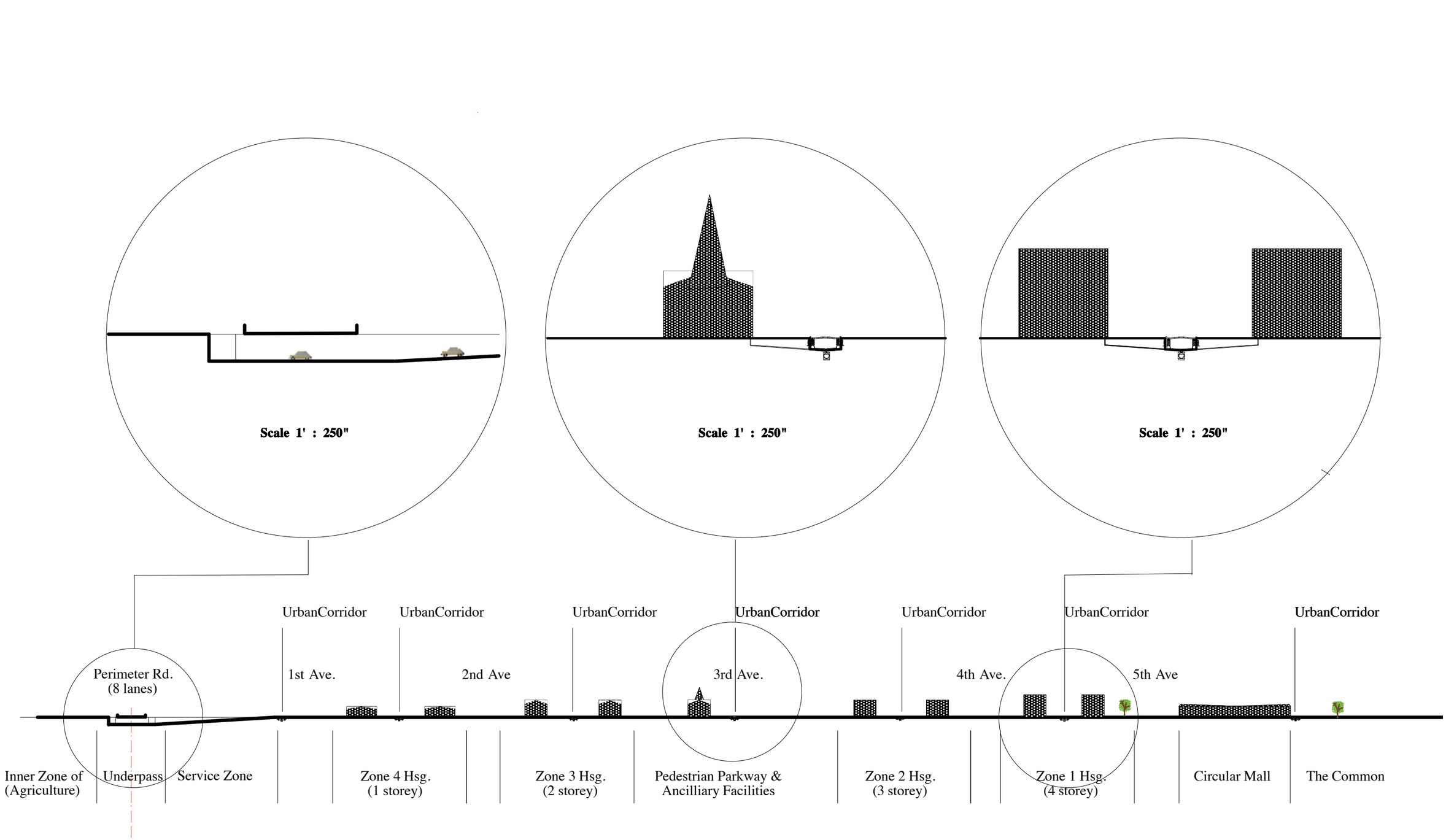
An Extrapolation of the Garden City
of
Ebenezer Howard

Scale 1 foot: 2,000 feet

Scale 1' : 250"

Scale 1' : 250"

Scale 1' : 250"



Scale 1' : 2000'

250 500 **1000** 2000

The Elements of an Autonomous Garden Settlement

Autonomous Neighborhoods

Populations of planned autonomous Garden Settlements will share the concept of all members working together at a neighborhood scale to maintain a high level of productivity and quality in their lives. To facilitate this goal, Garden Settlements are composed of duplicate Neighborhoods, each with its complementary agricultural A'ha'a'pua that can function independently for indefinite periods without external assistance. Since each neighborhood is autonomous, incremental growth of Garden Settlements is possible. This will encourage neighborhood scale incremental growth until the ultimate planned Garden Settlement size is reached. The plan of typical neighborhood is portrayed in Figure 9.

Bundling Utilities and Services into Urban Corridors

Partly because of historical antecedents, bureaucratic factionalism and laissez-faire policies, utilities in municipalities such as electricity, various communication media, water and sewage systems, and various methods to transport goods and passengers, were implemented by various institutions, groups or individuals, in various locales at various times. The resulting assemblies of overhead wires, buried pipes, steel rails, paved roads and expressways that crisscross each other en route to reach or join together conurbations, cities and towns and to provide services such as electrification in rural areas and hubs in remote locations and water for mining and manufacturing operations have left municipalities in varying degrees of chaos. Implementing and maintaining utilities and services individually has proven to be often redundant, ultimately inefficient, and extremely costly to re-engineer.

A common carrier with shared points of distribution of the various infrastructural services would reduce redundancy and costs, is a most obvious solution but too difficult to undertake because unraveling the multiplicity and complexity of the many layers of private and public infrastructure is too formidable to undertake. Instead, utilities and services are continuously being overlaid by new partial installations resulting in ever denser and taller utility poles, multiples of thicker wires, more excavations of roads to reach buried pipes, and more elevated or tunneled roadways, all of which are costly and contribute to further invasions of human environmental space.

An opportunity to rework or replace the complexity of current systems with a much simpler and more rational system that respects the natural environment and the quality of human spaces are Urban Corridors (Figure 9) and their adherence to the principles of the closed circle, limits to size, location and density that are fixed in the planning stage and with a clear understanding that the objective of utilities and services is to directly service Garden Settlements and their neighborhoods. Routes for all utilities and services could be

bundled together to follow common hierarchal paths to distribute utilities and services in a manner that leaves human environmental spaces throughout each Garden Settlement undisturbed.

Simply defined, Urban Corridors are, as are their Regional counterparts, conduits that carry all fluids, gases, electrical energy, digital and electronic information, people, goods, liquid and solid wastes, necessary to maintain the functioning of Garden Settlements while leaving the spaces for human activities undisturbed. An Urban Corridor may be submerged, sunken, or elevated but, except for small, slow moving vehicles limited to internal Garden Settlement circulation, may never be at the same level as pedestrian traffic.

Gravity Neutral Corridors,

Because they always remain absolutely level within a garden settlement, Gravity Neutral Corridors can transmit fluids in pipes along corridors without pumps to overcome changes in elevation and to automatically function as storage containers. All urban uses and activities are directly plugged into, attached to or connected to an Urban Corridor so that extended lateral or cross connections are eliminated. Housing, commercial, industrial, recreational, government, health, educational and all other structures that require services can plug directly into a Corridor. A typical Urban Corridor plan with cross-section views of typical examples of Urban Corridors are shown in Figure 9.

Nodes

Nodes, in Garden Settlements, are located at intervals along perimeter Urban Corridors. They can provide a number of functions: shuttle stops for Urban Corridor transit passengers. Nodes connected to external road systems act as filters to check incoming goods and vehicles to ensure they comply with community environmental standards. In times of emergencies, nodes could act as check points to filter out undesirable visitors.

Internodes

Along the space between nodes and contiguous to the Service Zone, but still within the Settlement Green Line, Garden Settlements may have a shuttle circulation route on the outer perimeter that, in addition to having a circulation function, may also have housing with commercial quarters such as shops and small businesses and neighborhood social infrastructure such as primary schools, chapels and health clinics to generate a mixed use zone that serves also as a social space much as do the streets of older inner city neighborhoods

Boulevards

In the classic Howard Garden City, boulevards are the radiating roads emanating from the central park and terminating at the outermost industrial band. Boulevards are also the open space between adjoining Neighborhoods that may be arranged and utilized in many ways. Many European examples may have, in the centre of the boulevard, a broad pedestrian mall with play areas for small children, street musicians, kiosks with tables and chairs selling food and refreshments al fresco. Broad planter beds on both sides of the mall separate the mall from narrow sidewalks and vehicle lanes that hug buildings lining the boulevard to give convenient access to small shops and businesses. Shade trees in the planter beds may provide a

continuous leafy canopy over both the mall and the sidewalks and vehicle lanes. At intervals narrow pedestrian passages cut through the planter beds to connect the mall to the vehicle lanes and sidewalks. [lvii]

Streets in the Sky

For larger Garden Settlements with medium height multi- storey residential structures, Streets in the Sky combines the benefits of housing on streets at grade level with the economies of multi-story living by reproducing small residential streets at their upper levels. In addition to linking residential housing by public streets, long recognized as a neighborhood building tool, Streets in the Sky can also link communities and multi-storey human settlements together through an extended network of street bridges at the upper levels to enable residents to move freely to facilities on upper level floors of neighboring buildings.

The Common

The Common is a traditional communal space in many cultures, usually in the form of a public space created by an enclosure of surrounding dwellings usually in a circular configuration. In earlier times, it was used to secure livestock at night and as a place where public festivals were celebrated. Today, commons have more uses relating to activities for urban dwellers in high-density areas. Garden Settlements will always have a Common for the use of the residents of the settlement, accessible in a matter of a few minutes walk. For Garden Settlements with circular or loop configuration the innermost open space will always be designated as the Common. Because a Common lies in the centre of a circular Garden Settlement, the surrounding bands of residential structures being relatively thin bands of built environments would need only a short walk to reach both interior and exterior natural environments. With a narrow cross section, not much wider than that of a 4-lane highway, sunlight and breezes can easily penetrate all enclosed built spaces while views to natural environments are afforded to all city residents.

The Attributes of a Garden Settlement

Pedestrian Circulation

The limits of pedestrian travel[lviii] determine the diameter of a Garden Settlement. In *Tomorrow, a Peaceful Path to Real Reform*, Howard determined this to be one and one-half miles. Additional travel routes can extend beyond this dimension to include the Service Zone, the Perimeter Road, and the Inner and Outer Agricultural Zone. [lix] These determine the optimal dimension for pedestrian travel from home to work, to lower, intermediate and upper schools of which there is one lower and one intermediate school in each Neighborhood and to shopping sites to purchase household goods. Casual, spontaneous, and infrequent trips for sundry purposes are not included in the table. Public services such as public health facilities and government emergency and administrative services located within the Circular Mall that would, depending on their exact location in the Mall, not exceed the radius of the Settlement plus the radius of the Common.

Sample routes for pedestrian and bicycle routes plotted on a Garden Settlement plan, with the distance traveled and estimated elapsed time for a one way trip are recorded on an accompanying table for trips

between home and workplace, home and school. There is one pre-school and one lower school located in each Neighborhood and one Upper-school located in the Circular Mall while shops, that serve the entire Garden Settlement for household essentials are located in both Neighborhoods and the Circular Mall.

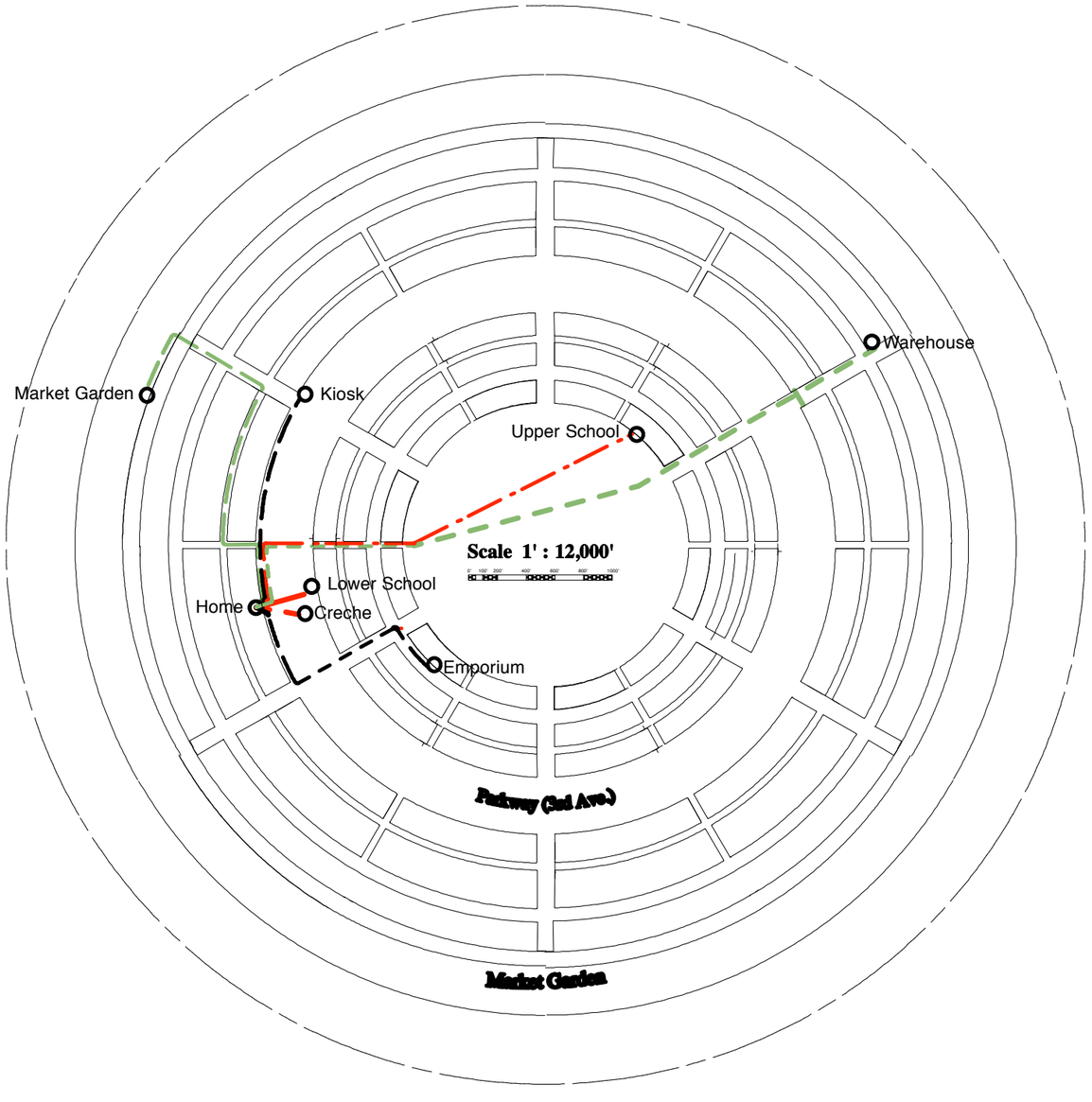
To reduce the number of variables, the point of origin and destination for each mode of transportation is the same. An example of pedestrian and bicycle travel modes are tracked for an imagined family of five living in Zone 3, whose father is a dispatcher for a package delivery service that is located in a warehouse

Figure 11

Garden Settlement Pedestrian Circulation Pattern

An Extrapolation of the Garden City
of
Ebenezer Howard

Scale 1 foot: 12,000 feet



Legend

Destinations

Work

School

Shop

Participants

Father

Mother

Eldest Child (Upper School)

Middle Child (Lower School)

Youngest Child (Pre school)

Table Of Daily One Way Travel From Home To` Destination

Member	Purpose	Destination	Distance	Walk Time	Bicycle Time
Father	Work	Fed Ex Despatcher	5777 Feet	22 minutes	12 minutes
Mother	Work	Market garden	2779 feet	12 minutes	7 minutes
Eldest Child	Student	Upper School	2710 feet	12 minutes	7 minutes
Middle Child	Student	Lower School	1160 feet	7 minutes	5 minutes
Young Child	Pre-school	Creche	1095 feet	15 minutes	
Eldest Child	Snack	Kiosk	1544 feet	10 minutes	5 minutes
Family	Misc.	Lotus/Tesco	2267 feet	11 minutes	5 minutes

in the Service Zone almost diametrically opposite from his home; whose mother, in addition to housekeeping also farms a Market Garden allotment in the Inner Agricultural Zone; whose oldest child attends High School which is located on the far side of the Circular Mall; whose mid-aged child attends Lower School in the 3rd Avenue Parkway; and whose youngest child attends Pre-school also in the 3rd Avenue Parkway, to which the mid-aged child escorts the youngest child between home and school during the academic year.

The Stabilized Society

Because Garden Settlements are planned in much the same manner as a commercial venture is planned, the constituents and scale suitable for each Settlement can be pre-selected to achieve the highest operating efficiencies. Energy consumption and capital costs for private and public plant and equipment can be calculated to achieve the most cost-effective design. Industries can be chosen that can be synergistically linked so that the bye-product of one plant can become another plant's raw material. Redundancies in infrastructure can be eliminated because the population of the town has been predetermined and the infrastructural plan can be specifically detailed to meet the projected population needs. In contrast, the amount of wasted time, equipment and energy in existing towns and cities, through duplication of capital investments, infrastructure and civic services, even in the most advanced countries, is staggering. Minimizing redundancies and making infrastructure directly accessible to industry and commerce through pre-planning would result in savings and efficiency.

Another aspect of stability is sustainability, defined as Autonomous Garden Settlements, that can remain operational and supplied with essentials of energy, basic and balanced foods and the continuance of daily functioning of households, schools, workplaces and transportation, for indeterminate periods. To be a sustainable garden settlement is desirable not because it is fashionable to be so but because sustainability

reduces the need to shuffle basic consumables from city to city, region to region and nation to nation thus increasing operational efficiency and reducing costs of goods and services. Sustainability also provides the opportunity to reduce costs by "do it yourself" or co-operative methods and to assure the quality of produced goods such as organically grown foodstuffs as well as assuring, in times of emergency, an uninterrupted flow of essential goods and services. While it is essential to maintain the capability of self-sustainability, the growing of cash crops for external consumption and other normal productive activities of trade and commerce may also flourish. All of which can take place in a pollution free environment and are acceptable providing the flows in the resource recycling loops of Garden Settlements are maintained.

Since Garden Settlements seek to achieve autonomous sustainability, agricultural lands should be located nearby or contiguous to their Garden Settlement. Unlike traditional farms, future agricultural activities will be more intensive and will be more productive while utilizing a comparatively smaller proportion of land. Circular settlements will seek agricultural areas that preferably circumscribe the settlement in a regular band configuration so that the outermost boundary more or less follows the configuration of the settlement. This ensures that working and irrigating the farms can be done more efficiently by the settlement since farmers can also be settlement residents and their farms can benefit from the harvested rainfall from settlement surface drainage systems and natural fertilizer from settlement septic tank effluent when combined to irrigate their farms.

The innermost agricultural band closest to and surrounding the city is reserved for intensive market garden produce that is cultivated and harvested all year on a daily basis.[lx] This band, that circumscribes the boundary of the built city acts, because it is continuously cultivated under the watchful eyes of farmers and filled with densely planted growing produce, functions as a moat to control urban expansion from the inside and infiltration by squatters from the outside. The Perimeter Road that circumvents the garden Settlement clearly defines the boundaries of the settlement, beyond which no further settlement can occur. Secondary roads to service the outer agricultural and husbandry Zones can only loop out from and return to the Perimeter Road of a circular Garden Settlement.

The Quality of Life

It is generally acknowledged that the design of space for human use at some point departs from the merely rational and utilitarian to become an emotional experience. Certain combinations of colors, textures, and formation of built environments may matter more than others. Sometimes these are experiential and sometimes they are associated with traditions whose origins may not be known but without whose presence, may give rise to a sense of loss. This experience is oftentimes associated with traditions and spiritual matters. Where historical, religious, or cultural icons do exist on or near a site intended for the construction of cities and communities, steps must be taken to preserve and somehow incorporate these icons into the design of Garden Settlements.

These traditions of city building are described in the works of Lewis Mumford, one of the most vocal protagonists of the theory that civilizations and cities go hand in hand. Goals regarding the aesthetics of the

city require that settlements be built at a human scale; have a sense of place and open natural spaces and areas must be common and accessible to all.

To maximize these criteria and to preserve the sense of openness, neighborhoods would have stepped down building heights with the highest structures commencing at the center of double or single loaded Corridors stepping down to the lowest, possibly as low as one storey, at the outermost Corridor or Perimeter Road. This provides a complete array of housing accommodation from high rise penthouses to individual family plots so that all residential units, regardless of income level, have an unobstructed view, either inwardly toward the Common or outwardly toward rural pastoral lands, unobstructed breezes, ample daylight and sun exposure and, for the aged and the handicapped, ready access to geriatric facilities and a natural environment that will ensure an equal opportunity for those less fortunate or nearing the end of their lives to remain in their homes and to live with self-respect and dignity.

Chapter V

The Anatomy of a 21st Century Garden Region

Even the smallest, most minute and delicate ecosystems and habitats,
some so small as to escape the human eye, are an inextricable part of a regional ecosystem

Defining a Region

Regions do not adhere to fixed sizes or boundaries. They may arise from a number of attributes such as being defined as a particular part of the earth, characterized by distinctive geography, florae, ethnicity, climate, language, religion, politics or derived from commercial or military expansionism. Many regions are defined by political and administrative dictates such as international, provincial, county and municipal boundaries or by geographical features such as mountain ranges, lakes or rivers. In all cases political and geographical anomalies are likely to occur. Political boundaries are conventionally described by angular lines, which rarely take into consideration geographic features or existing ethnic or tribal boundaries. Boundaries that are defined by geographic features such as rivers do not take into account the fact that rivers define a natural region that includes both sides of the river. Ethnic societies in colonial times often found themselves divided among two or more contiguous national boundaries or by divisions of natural resources such as iron separated from the coal needed to smelt the iron ore. As a result, many regions defined by political or geographic boundaries cannot serve the populace of a region in the most efficient or appropriate manner.

Regions may also be determined solely by variations in climate, florae, faunae, or terrain. Awareness of this will greatly assist in identifying specific locations to be used as preservation areas, to grow specific agricultural crops within a region in order to maximize agricultural productivity and preserve the existence of endangered species and to determine the appropriate locations for Garden Settlements and Social Cities. Garden Regions that transcend the bureaucratically driven labyrinths of national, state, provincial, county and municipal boundaries to create functional collections of a diversity of natural resources at a scale that will optimize the qualitative and economic needs of a resident population. Defined in this manner regions would be, in synergistic terms, coteries of Garden Settlements that collectively would occupy and manage Garden Regions with borders that would be contiguous to each other to ultimately reach a continental scale to more efficiently facilitate the natural flow of flora and fauna and inter-regional commerce.

While regions are sometimes determined by built environments such as railroad and highway rights of way, strategic security considerations or by arbitrary geopolitical manipulation, these do not define a natural region. It is geographic features such as watersheds, valleys, rivers, lakes, islands and oceans that determine a natural region and a conscious selection of related natural features that collectively better utilize the resources within geographically defined regions.

A Hawai'ian Model

An excellent example of this definition is the method devised by the Hawai'ian elite to ensure an adequate, equal and diversified distribution of food among their subjects. The Hawai'ian Islands are of volcanic origin with mountain ridges extending high into the sky and steep flanks sloping down to an ocean shoreline of volcanic rock outcrops interspersed with sandy beaches and to shoals extending to coral reefs some distance from the shoreline. High mountain ridges intercept incoming clouds causing frequent rainfall that cascades down the mountain slopes through forests of temperate trees at the top to tropical trees at the bottom, where the mountain streams empty into the shoal waters surrounding the islands. The Ali'i [lxi] divided the land running from the mountain tops to the outer perimeter of the coral reefs into broad strips, called A'ha'a'pua, each wide enough to support a settlements. By dividing their islands into vertical strips of land and sea that extended from the tops of the mountains to the off shore reefs to the to include a range of climates from temperate to tropical and a corresponding range of soils, vegetation, florae and faunae, the inhabitants of each A'ha'a'pua were able to extract a rich and varied harvest from the sea, to hunt animals on the mountainous slopes, to grow a wide variety of crops at various altitudes and to reuse the rainwater that cascaded down the mountainsides to successively irrigate crops at the various tiered climate ranges.

By utilizing the geography of the land and ocean to produce regions with the utmost in volume and variety of foodstuffs the A'ha'a'pua was an eminently practical regional design methodology that was successful if measured by the stature, strength and health of Hawai'ians before their numbers and health were radically diminished with the arrival of European settlers accompanied by their foodstuffs and diseases against which the Hawai'ians had no defense. It is this model that is most appropriate for Garden Settlements in Garden Regions '

A GIS Model for Mapping Garden Regions

Garden Regions should have as many variations of climate, florae, faunae, geography, resources, and terrain as possible. Awareness of these variables will greatly assist in identifying specific locations to be used as preservation areas, to grow specific agricultural crops and of the various florae and faunae within a region in order to maximize agricultural productivity and preserve the existence of endangered species. Being aware of variables within a region will greatly assist in locating and formulating the type and character of Garden Regions and their Garden Settlements.

Until recently tools that could easily and accurately define or create a synergistic region did not exist. The advent of Geographic Information Systems (GIS) has now made it feasible to do so. It is now possible to view all the inhabited, and many of the uninhabited and pristine parts of the world without the clutter of political and economic interests and boundaries in order to discover what are natural geographic regions and their synergistic possibilities. Data banks now exist that cover most of the inhabited parts of the world. The data banks include not only statistical data but also data that can visually create three dimensional images of topography, the built and natural environments and, with the aid of remote sensing, can identify, among other things, types of florae, soils, subterranean minerals and ground water.

Using remote sensing (GIS), global positioning (GPS) and subterranean sensors, it is now possible to exactly determine the extent, content and relationships of regions and, within regions, the location and scope of arable lands, the volume of potable and irrigation water, underground minerals and grade level botanical and animal resources including types of soils most suitable to grow particular crops. Using Global Positioning Sensing (GPS) will enable boundaries, no matter how convoluted, to be located to within a few inches in order to stake out boundaries of such categories of geographical features as soil types and bodies of water. These capabilities will change forever the way to plot boundaries of regions and the determination of where to place Garden Settlements and their ancillary facilities. No longer will it be necessary for surveys to delineate amorphous geographic formations by awkward angular straight lines that inaccurately delineate the fluid lines of nature.

These data can be recorded on multi-layered transparent maps with the base layer showing the natural boundary lines of Garden Regions and their relationship, on maps similar in format and scale, of contiguous Garden Regions to identify potential synergistic relationships. Also included in the base map are the relative heights of the terrain described by contour lines drawn at regular intervals of height. A second layer superimposed upon the first layer would indicate the underground resources present within each region giving their location and volumetric dimensions. A third superimposed layer would describe the resources and geographic features upon the surface of the region by locating, classifying and quantifying each resource by volume and area. A fourth superimposed layer would map and describe the quality of air throughout the region, prevailing wind directions and types and sources of man made and naturally generated noxious or toxic gases. Before making planning decisions, a Garden Region must be completely mapped on a fifth superimposed layer to reveal all resources that will determine the population carrying capacity in terms of self-sustenance in food, energy and existing human interventions.

Mapping of a Garden Region will reveal its carrying capacity of human populations in terms of arable land, natural energy sources, Gravity Neutral determined circulation routes and Garden Settlement morphology, to achieve the proper ‘fit’ with the natural environment.

The Elements of a Garden Region

Regional Corridors

Regions typically contain hierarchic networks of roads that crisscross regions that increase in density as regions grow in population. Networks of electrical and communication rights of way also cross regions leaving telltale rows of poles and steel towers to mark their paths. They are joined by other rights of way for such underground services as gas lines, and water mains. Roads and rights of ways that intersect create a jigsaw of land parcels defined by bounding networks of roads and rights of way. Each intersection creates conflicts for traffic and interference between services if they are at the same level. Building underpasses or bridges to allow the flow of traffic to proceed unhindered is costly. As the land is further developed and divided into ever-smaller parcels, the impact on the environment becomes more severe, leaving wildlife trapped in ever-smaller ranges and making farming more difficult to carry out efficiently. Presently, in spite of the fact that road and utility networks are intended primarily to service human

settlements they invariably follow separate, sometimes circuitous routes, that sometimes appear to defy logic, to reach the their destination.

Regional Corridors are intended to replace the patchwork of land utilization and the jigsaw of interlocked roads and highways with a single Regional Corridor to open up the land to more appropriate uses, to recover the vast areas of often fertile lands dedicated for rights of way, to directly and economically connect population centers and to enable the disposal of the multitude of decrepit small bridges and obsolete little used roads. Such should be the next generation mode of national, inter-provincial or inter-state infrastructure.

Connectivity, based on the continuity of flow of the closed loop or circle, at each level in the hierarchy of Regional Corridor loops serve firstly Garden Settlements, secondly inter-connected Social Cities, thirdly inter-connected Garden Regions and fourthly Continental routes, so that the movement of goods, services and people can be balanced horizontally among the Garden Settlements and vertically from Garden Settlement to Continental distribution systems. Vertical and horizontal distribution along common paths assures the flexibility to balance utilities and traffic loads.

If Regional Corridors are built as conventional road/rail/wire/pipe systems at grade level, as is presently the practice, ecosystems are interrupted, the flow of rivers and streams interrupted, innumerable acres of agricultural land are lost to rights of way, forests become discontinuous, wild life migrations are disrupted and strip development along the sides of highways is inevitable. Regional Corridors, elevated slightly above the undulations of the natural terrain would eliminate these problems to yield the additional benefits of electrical and communication lines and water mains contained within the elevated Regional Corridor above flood and storm surge levels and protected from high winds, of well drained roads to avoid dangerous puddles and icing conditions and, because of the varying clearance between the underside of Regional Corridors and the undisturbed vegetation of the natural terrain below, allow for the free flow of rivers, streams and surface drainage and the free passage of wildlife, along the extent of the Regional Corridor.

To maintain uninterrupted traffic flow, Regional Corridors do not allow intermediate access and exits en route between Garden Settlements or Social Cities. This limits access to lands bounding Regional Corridors to be only accessible from within Garden Settlements via the circumscribed inner and outer agriculture zones looped secondary on-grade road systems that originate and return only to their own Garden Settlement. This prevents traffic originating in one Garden Settlement to directly connect to other Garden Settlements , existing villages, towns or cities and, most importantly, to block unauthorized access to pristine Preservation zoned lands with their indigenous flora and fauna and natural geographic features.

Inter-Garden Settlement and Social City transport must be efficient in terms of energy consumption and elapsed travel time. For minimum elapsed times, inter-settlement Garden Region Corridor routes must be able to flow smoothly with minimal changes in speed from departure to arrival and with no intermediate interruptions. For minimum energy consumption, inter-Garden Settlement routes must follow the same

contour grade line so that, after initial acceleration, vehicles can proceed at a steady pace using only the energy required to overcome rolling and wind resistance.[lxii]

Since Regional Corridors are the sole means of connection between Garden Settlements, they must be linked together in closed, level loops so that, in the event of an unforeseen interruption to the delivery of the flow of people, liquids, gases, electrical and communication services and goods can be managed by dividing or reversing the flow and maintaining constant equilibrium throughout the unaffected part of the closed loop. The same principle applies to the entire hierarchy of Garden Settlements from the closed loops of Garden Settlements, Social Cities, and Garden Regions to the ultimate level of inter-regional closed loops at the continental level. This would require modulating Regional Corridors with existing natural water flows between mountain ridges and sea level. [lxiii]

The design of regional corridors must be flexible enough to account for a variety of transport methods for people via automobiles, light rail, vans, buses and in the future, guided or entrained systems of vehicles; of goods via trucks, guided self propelled containers or belt driven conveyors inter-changeable between Regional and Settlement Corridors; of liquids including potable, domestic, industrial and irrigation water, sewage for recycling, commercial liquids; of commercial gases; of electrical energy; of communication electrons; and of continuous enclosure of Corridors in inclement climates. Consolidating all these services for Garden Settlements in a Garden Region into a single corridor will have a beneficial synergistic effect in terms of capital costs, economy, aesthetics, and maintenance.

From above, a Regional Corridor would appear as a multilane expressway with a total absence of other or branching transport systems being present to mar the natural scenery or, in the case of an encased corridor in areas with extreme weather as a white sinuous curvilinear form whose sculptural qualities would complement the organic qualities of nature and, there being no other roads, rights of way, rows of wood poles and steel utility towers crisscrossing the landscape, to gracefully wind its way through pristine forests or over rolling prairies. Seen from the ground, a regional corridor would appear as a continuous form that appears to float slightly above an undulating terrain. Such should be the goal of the next generation of national infrastructural renewal whose time, in view of the growing competitiveness between nations in the first decade of the 21st century, has come.

To not disturb the terrain over which a Regional Corridor would pass, a basic, inexpensive construction method utilizing piles and caissons of various sorts, placed a modest distance apart, would be used as foundations and columns to support simple corridors above the existing natural terrain with pre-cast concrete caps, placed on the piles or caissons to support pre-cast concrete beams spanning between the piles. The multiple decks upon which vehicles would ride would be pre-cast concrete planks resting on the beams and spanning the width of one traffic lane width . After assembling caps, beams and deck, post stressed wire would be passed through the beams and planks to create a highly stressed module. Since the corridor follows the curvilinear path of a contour line, the pre-cast concrete planks have, in plan view, a truncated triangular shape with a skew of approximately 5 degrees. By combining the modules in increments of 5 degrees, curves in any direction may be made.

Construction could follow the same procedures used to construct traditional railroads i.e., flat cars deliver gravel, wood ties, and steel rails in succession to the railhead. These are offloaded and, after the gravel bed and wood ties are leveled, the steel rails are spiked to the ties. Flat cars, replenished with new loads of gravel, ties and rails, would advance the length of the newly laid rails and the procedure would be repeated. Regional Corridors would likely be built largely with concrete because of its ability to be formed into many shapes that can be cast and when hardened will lock together. These pre-cast concrete piles, caps, beams, planks would have recesses and holes for piping and conduits of the various electrical, fluids, gases, and communication cables already cast in place to enable quick installation of piping and conduits. Concrete side rails for the elevated corridor, with waist high side-mounted recessed road lighting to avoid unsightly utility poles supporting overhead lighting that lights up the sky as well as the road at an inordinate expense of electricity, would be an integral part of the corridor. .

Building a basic Regional Corridor would follow the traditional steel railway method-

1. A mobile crane to which is attached a pile driver at the end of its boom would place and drive the requisite number of piles one module distance ahead of the corridor head.
2. A second truck with pre-cast concrete pile caps would position them to enable the mobile crane to lift the caps from the truck and place them on the pile/columns and a third truck would bring the beams that would carry the road planks.
3. A fourth truck would deliver road planks, also to be placed by the mobile crane, on the supporting beams.
4. When all components are assembled, a post-tensioning crew would string together the beams and planks with post tension wires to create homogenous corridor modules.

Using this post stressed method of construction allows disassembly of the corridor for realignment or replacement of precast elements without any disturbance to the surrounding terrain so that, other than the act of driving piles, the existing terrain remains untouched and the risk of soil run-off and environmental damage is minimal.

Regional Land Use

To simplify land management only four categories and two special zones are used to define the scope and uses of land within a region. Matching land use to land type is based on a best use/ residual determination.

Agricultural lands

1 The highest priority in land use goes to land most suitable for agricultural purposes.

2 Agricultural land is delineated by the configuring land that is suitable only for agricultural and other husbandry purposes. Organic rather than geometric lines should delineate agricultural lands. These are easily determined by using one of the numerous types of Global Positioning (GPS) devices that enable staking out on the ground and accurately locating on a survey map the whorls and turns defining classifications and types of agricultural soils.

3 Agricultural lands cannot be subdivided into land parcels for any use other than husbandry[lxiv]. Size and configuration, located by GPS, can be delineated to suit the husbandry activity to the terrain, soil and in situ flora and fauna.

4 No dwellings for human use may be built on agricultural lands. Farmers commute to their farms from their nearby Garden Settlement[lxv].

5 Utility buildings on agricultural lands must be constructed of biodegradable non-metallic or non-plastic materials that retain their natural surface texture and color to blend with the natural landscape.

6 Agricultural lands may never be changed to another land use except for dormant agricultural lands that will change to Preservation status after a certain period of dormancy. They may be reclaimed for agricultural use only when a perceived need for more agricultural land arises.

7 Roads in agricultural lands are limited to porous paved roads that originate at one point in a Garden Settlement and loop back to return at a different point of the same community. Agricultural roads cannot be connected to agricultural roads of another Garden Settlement or any other road system or community.

Preservation lands

1 The middle priority in land use goes to land suitable for preservation purposes. Lands suited for inclusion in this category would be lands with existing stands of indigenous flora, fallow and marginal agricultural lands, wetlands, rainfall catchments and water storage areas and impassable areas.

2 Private unused or abandoned lands and rights of way and the like are also to be included in preservation lands.

3 Preservation lands should be replanted with indigenous flora if the need for replanting arises.

4 Unassigned, leftover, federal, state and municipal lands fall into the of preservation lands classification.

5 National, state and municipal parks and recreation lands are included in the preservation classification

6 Management of preservation lands will be actively and aggressively pursued through reclamation and planting and severe restrictions on felling trees.

7 Areas inside Green Lines will be supervised by the preservation authorities (see Green Lines below).

Garden Settlement Lands

1 The lowest priority in land use goes to land suitable only for human habitation purposes.

2 Cities and communities may never be built on lands suitable for agricultural purposes. They should, however, be located contiguous to agricultural lands, from which they can procure foodstuffs.

3 Cities and communities should be located on land adjacent to resources suitable for commerce and autonomy with respect to energy, food, and water.

4 Since cities and communities are built for a specified population, land assigned for settlement use will also be configured to a shape appropriate for pedestrian travel.

5 In addition to land for buildings and circulation use, city and community lands will include land for a common and a water catchment area.

6 Cities and communities must never be built on lands subject to ocean storm surge and tsunami, flood plains of rivers, lakes or arroyos, on seismic fault lines, contiguous to active volcanoes, in wetlands or in the path of the natural flows of rivers, streams or springs.

7 Cities and communities should be located on land proximate to their economic activities and resources, their agricultural land and transportation services; land with views, natural ventilation and sunlight.

The Green Line

1 Green Line restrictions may be applied to agricultural, preservation and human habitation land classifications

2 The Green line is used to circumscribe certain parcels of land in which special environmental conditions and uses apply.

3 The special environmental conditions include-

- ❖ Internal combustion engines emitting carbon dioxide and particulates are prohibited.
- ❖ To assure ample open space, building footprints are limited to a minority percentage of the circumscribed Green line area.
- ❖ Building height, other than for Garden Settlements, is limited to the average height of surrounding vegetation. Vegetation heights less than one-story high limit structures to one storey.
- ❖ All roads must have porous planted surfaces with no margins between roads and surrounding terrain.
- ❖ All roads entering a Green line area must terminate in a dead end within the Green line area.
- ❖ No vegetation may be cut down or removed without permission from the Preservation authorities.
- ❖ Noise levels must meet minimal standards

4 Appropriate uses could include-

Resorts, historical sites, geographical sites with outstanding features and access thereto, hiking trails and public parks.

5 All Garden Settlements fall within Green Line areas.

The Red Line

1 Red Line restrictions are applied to lands that are dangerous to animal and human health or life.

2 The Red line is used to circumscribe certain parcels of land in which dangerous environmental conditions and uses exist.

The Attributes of Garden Regions

The Garden Region Environment

Although the human species may choose to ascribe to itself certain occult properties, humans remain in scientific terms, a part of a wonderful and beautiful complex of interacting organisms that together give life to our otherwise inanimate world. A garden, in this world, is a plot of ground used for growing and sustaining creatures, trees, plants, flowers, fruit, or vegetables and a garden settlement is a manifestation of that ecology—a way of living in harmony with nature.

Within a Garden Region are ecologically autonomous, self-sustaining, non-contiguous, detached Garden Settlements, whose footprints extend beyond their built environment to include agricultural, preservation and watershed lands. The residual or left over lands between Garden Settlement lands are subsumed under Regional Preservation lands, that intertwine between and around Garden Settlements to continuously link preservation lands together at a continental scale in order to allow wildlife and plant life to freely move and grow throughout a Garden Region ecosystem. Contiguous Garden Regions would align their regional preservation lands to allow migratory animals and plants to freely pass from one Region to another in their annual migrations and seasonal growth patterns. Following this regional open path system, whole continents would thus be open to transitory animal and plant populations to maintain a natural balance in bio-diversity. In this concept, when viewed from above, Garden Settlements would appear as islands in a virtual continental park extending from sea to sea.

Even the smallest, most minute and delicate ecosystems and habitats, some so small as to escape the human eye, are an inextricable part of a regional ecosystem and, if destroyed by settlement activities or their toxic pollutants, may irreversibly corrupt the environmental health of regions. In sustaining themselves, Garden Settlements and Regions, should guard against this disaster by carefully extracting and replenishing regional resources in concert with their seasonal rhythms and to avoid resources such as rivers, streams, forests and arable lands when locating Garden Settlements. Sufficient habitat and biological diversity should be conserved to recoup losses incurred by the insertion of Garden Settlements into Garden Regions. Being aware of this mandate within a Region will greatly assist in locating and formulating the type and character of a Garden Region and their Garden Settlements. This may be accomplished by allowing the terrain, with its existing configuration and biological and habitat diversity, to locate and shape Garden Settlements. This avoids present site development practices of using bulldozers to reshape the terrain and chainsaws to erase existing biological habitats. To accomplish this, the role of forest and park rangers must be transformed from their present passive roles into an active force, acting in concert with the administration of Garden Regions, to manage and police Regional environments. Many regions may already contain existing settlements and populations. These must be taken into account in determining the size, location, and carrying capacity of new Garden Settlements and land uses within the Garden Region.

Chapter VI

The Imperatives

'….starvation, total devastation, global warming, annihilation, tsunami, massacre, environmental extermination, carnage, volcanic eruptions, butchery; genocide, homelessness, ethnic cleansing, ….'.Wikipedia, 2012

Some precepts cannot afford the measured pace of city and regional planning and execution. In the short period since the beginning of the 21st century, the world has already experienced major catastrophic events that, with the extent of human suffering and death incurred, demand their immediate mitigation or that, with their strategic position or timeliness in the management of human affairs must be commenced as soon as possible. These imperatives, because they should be undertaken as soon as possible must deal simultaneously with both their tactical and strategic issues. For these reasons the imperatives attempt to elaborate the details and processes of their implementation.

Finding the Right "Fit"

One of the most critical environmental interventions by humans is creating peripheral and outlying subdivisions or, less frequently, new satellite cities. Developers invariably seek flat sites that, all too frequently, are agricultural lands. If flat land is not available, bulldozers and chain saws are employed to remove hillocks, trees and stone and earth outcroppings and to fill in depressions, ponds and streams until the whole building site is completely flat and devoid of vegetation. Upon this flat surface, surveyors and planners inscribe a pattern of odd shaped lots and combinations of straight and curving roads, perhaps so designed to simulate the randomness of a natural environment[lxvi]. After almost all vestiges of the original natural environment have been erased during the process of site development and building construction, paved roads and sidewalks, a patch of green sod for a front yard that is sometimes embellished with a sapling, are substituted for the original natural landscape. This process, varying in degree of degradation, to the natural environment, is repeated world wide in westernized enclaves and, coupled with existing human settlements that often include massive slums, are the major contributors to environmental deterioration.

From the advent of the Industrial Revolution to the present, technology, technocrats and a hugely increased human population ensconced in conurbations have separated humans from their natural environment and thwarted their capacity to rationalize solutions to present day environmental problems. Politics, religious dogma, big business and a misplaced faith in technology have all failed to solve the environmental problems that now appear to be on the verge of plunging the world into an unknowable future. To counter this trend a better fit between natural and man made environments must be found. Finding the right "fit" means integrating human activities with their natural environment in a sustainable

manner to assure a continuing, long-term alliance in their mutual preservation within and surrounding Garden Settlements and Regions.

Resource extraction, food and manufacturing production and the construction of infrastructure and the movement of goods, services, and people all intrude into the natural environment. In a world still tinged by the 'man conquers nature' syndrome, physical conditions detrimental to human intervention are quickly removed or modified resulting in interruptions to the natural life and flows of organisms and the flow and transformation of inorganic materials. The breadth and scope of natural environments lost in this manner can be assumed to be a factor in environmental degradation and climate change, lending urgency to the need to change the fundamentals of inserting home, settlement, and region into the natural environment. The fundamentals, now obscured by generations of technical textbooks, are the same for regions, cities, towns, villages, hamlets or a simple dwelling, varying only in relative scale. The ability to fit human shelter into the natural environment is an innate capacity shared by all humans since at least the beginning of the Paleolithic age but more easily discerned in the construction of human settlements in nomadic pre-industrial societies.

Pre-industrial societies provide simplified models of "fit" between context, technology and resources because context and technology were not as complex as those in post-industrial societies and resources were close at hand. The Plains Indians of North America, the Mongols of the Steppes of Central Asia and the Eskimos[lxvii] of the Arctic appear to be examples of a good "fit". Based on a nomadic way of life, which precluded any form of built infrastructure, each society was organized into groups or tribes that managed a specific set of sites that were occupied on a seasonal basis. Extraction of resources from the sites was carefully managed by continual or seasonal movement from site to site to avoid over-kill of game or over-grazing of fodder.

Their shelters were constructed of locally extracted materials that included reeds, light timber, animal skins, sod[lxviii] and even snow. The techniques of construction were appropriate to the materials and tools available and anticipated much later discoveries by post-industrial societies of such sophisticated structural systems as stressed skin and dome construction.[lxix]

The Plains Indians devised shelters of light wood poles arranged in a conical framework upon which were placed the cured hides of Bison (Buffalo). When traveling during their seasonal migrations, the Indians used the poles of their homes as a framework to carry their household goods, wrapped within the knitted together skins used to cover of their igloo and towed, dragged or carried from site to site. The primary source of food and shelter materials were obtained by hunting the vast herds of Bison that grazed the plains and who provided meat for food, skins for shelter and clothing, bones for instruments and weapons and oil for medicinal and cosmetic purposes[lxx].

The Mongols employed a sophisticated method of assembling reeds into a folding accordion type framework that could be collapsed into a small bundle when traveling. An erected shelter consisted of a circular wall of expanded reed mesh surmounted by a curved conical roof, also made of a radiating reed mesh, were covered with skins of domesticated Yak (Buffalo) previously slaughtered for food, energy and

skins for clothing and shelter. The expanded reed mesh when laced together with the covering animal skins formed an extremely rigid but very light structure. [lxxi]

The winter homes of the Eskimos (Inuit) were built entirely of blocks of frozen snow cut in very complex shapes to form domes[lxxii]. Hunting for game on pre-determined widely spaced preserves assigned by their tribe, assured a balance between extraction and replenishment. Game, primarily fish, seals and whales, provided meat for food, skins for clothing and oil as energy for heating and lighting inside the dome.

In later periods, nascent civilizations lost their "fit" through their mismanagement of resources. These examples provide a lesson for post-industrial societies on how easily and how irrevocably a poor "fit" can destroy a society. A compelling example of mismanagement is the decimation of the population of the Easter Islands in the South Pacific in the 16th century that, because of their isolation from large landmasses, suggests a parallel of the earth in relation to the solar system. Visitors to the barren rock islands with their mysterious fallen statues cannot be expected to imagine that this same island, now largely inhabited by lizards and nesting sea fowl, was once a fertile verdant land watered by clear flowing streams and peopled by a society most likely resembling pre-discovery inhabitants of the Marqueses Islands.[lxxiii] The fallen stone statues or idols strewn throughout the islands were representations of deities of one of two tribes locked in an internecine struggle that ended only when all the trees had been cut down to make war canoes, fortifications, shelter and weapons. With all the trees gone, the fertile soil, no longer restrained by the root systems of the now extinct trees and bushes, was washed into the sea by rainfall and the remaining inhabitants disappeared leaving only the fallen idols.

A similar circumstance may have caused the mysterious disappearance of the Mayan civilization of Central America that, for many hundreds of years, maintained an agricultural system that retained an ecological balance with the surrounding forests. As a result of wide spread internecine struggles around 900 AD, refugees fleeing from the struggles sought shelter and sustenance in the forests causing disruptions to the sensitive forest ecology that ultimately lead to destruction of the forests and the withering away of the Mayan civilization[lxxiv].

Knowing how to accomplish the perfect “fit” means knowing how to build and manage regions, settlements, and dwellings to all fit, at their proportionate scales, into the natural environment. By building only what is functionally necessary with safeguards against the vagaries of nature; by marrying the contours of construction to the contours of the land; by being aware of maintaining the existing paths for drainage of surface water; by determining the types of soil upon which to build; by determining building orientation for the seasons and the aesthetics of views; by minimizing the extraction of organic and inorganic materials from the site; by choosing to build with materials that minimize processing and human energy; and by parsimoniously managing the energy needed to build the minimal spaces needed to sustain life in Garden Settlements.

Thus created, human settlements within a region's ecosystem are a part of rather than being a foreign and intrusive element, assure a harmonious co-existence in which fragile ecosystems will be protected,

important habitats preserved and Garden Settlements will exist in harmony with their regional ecosystems. Restraint of air and soil pollution, of artificial lighting and noise, and of the wholesale covering of open spaces with paving should be observed in order to make fragile ecosystems and habitats an integral part of the natural rhythms of human settlements.

The goal of reaching a proper 'fit' has already been recognized by The Living Building Challenge' a recently created national American organization that advocates "…[avoidance of] any further degradation" and "… completely reshape humanity's relationship with nature and realign our ecological footprint…to shift from a mechanistic model of architecture in which natural resources are viewed as fodder for construction to a more organic one, in which a building is designed to be fully part of and in balance with its ecosystem."[lxxv]

Ameliorating Holocausts of Another Kind

When disasters occurred, international agencies, such as the Red Cross and the Green Crescent and the United Nations, have provided limited succor in isolated instances. Such entities, however, have thus far proved inadequate in dealing with national, continental or world disasters. Their tactics have been localized and limited to short term measures that presume that disaster victims will ultimately be returned to their original location and style of habitation. These policies can, however, be transformed from palliative measures that employ standardized contingency plans and throw away aid packages into positive planning measures by focusing on developing aid packages that are suitable as a first step toward a sustainable future. A transformation that may need consensual acceptance of relocations to safer sites, a new settlement plan to better fit a new site, and new construction systems and architectural designs of human settlements for futures hitherto never imagined. This would require advance planning to create new settlements based on the needs of the 21st century so that if disaster does occur, remediation will not replicate past waste and missteps in the 20th century.

Recognition among scientists and planners, that ecological systems, of which humanity is a part, must simultaneously engage social, economic, and environmental aspects to generate strategies and plans for the 21st century. This opportunity, to correct or restore over-reaching errors committed in the past and to anticipate an uncertain future, should be adopted by national governments, public institutions and private enterprises alike. Past experiences show, however, that disaster plans for what may seem to be a distant future are not likely to occur before a looming catastrophic event impels their creation, often too late to be of any use.

Regions and nations can expect to experience, over time, at least some types of disasters, and their capability to manage these events will, depending on their economic, socio-political and environmental circumstances, vary widely. There are no standard plans or strategies that would satisfy all regions and nations, leaving this task to be undertaken by integrated planning that balances, for each unique region or nation, the most optimal, holistic and sustainable strategy. Thus, for each category of disastrous events, plans must include a broad range of criteria to be successful. These include social viability and

egalitarianism, economic feasibility, physical functionality, environmental pro-activity, strategic management in a regional context, tactical execution in technical and material terms, and redundant smaller resettlements rather than concentrated large resettlements to meet 21st century contextual conditions.

Within the first decade of the 21st century, a sufficient variety of disasters or near disasters have occurred from which may be derived strategies for similar, more widespread disasters in the future. These could encompass large portions of our planet, requiring new approaches to classify emergencies and catastrophic events and to devise strategies for their amelioration. Some suggested categories of catastrophic events that have already been experienced in the first decade of the 21st century are listed below.

Class 1 – Relocations - Anticipated events whose impact can be measured in centuries, such as rising coastal sea levels, major engineering works, changes in weather patterns. Since there is no prospect of returning to former domiciles, planning and construction of permanent alternate shelter can be linked to the pace of the event that is causing the relocation to enable a timely and appropriate solution. Such was not the case for the Three Gorges dam of the Yangtze River that took roughly 5 years. Within this period the government had ample time to properly research the residential circumstances and occupations of the soon to be displaced population, to make appropriate plans sensitive to these needs and to execute them.

Instead long rows of massive blocks of concrete housing were erected in locations remote from their original homeland to cause traumatic experiences among the displaced population. Within the available time the government could have formulated a relocation program to process, at an individual family level, the creation of smaller settlements, dispersed throughout their native region in housing reminiscent of their former situations and with the opportunity to resume their former occupations. An alternative that would have been less costly and would have reduced the social problems encountered.[lxxvi]

Class 2 –Instant Displacements - Disasters whose impact can be measured in decades, such as widespread dispersal of, either accidentally or purposefully, air borne nuclear waste or “dirty bombs”, toxic chemicals or deadly germs and of natural events such as major tornados, tsunami, earthquakes or volcanic eruptions are rarely anticipated. If the displacement is instantaneous, escape from conurbations, if there is no adequate, purpose built network of instantly accessible escape routes leading out of major urban centers and no early warning, only a very small proportion of resident populations could be expected to escape. Even if escape were possible, a huge, widely dispersed population in flight would be hard to reach and remediation by the conventional method of providing temporary throw away shelters and emergency rations, might not reach all victims before exposure and hunger would take their toll.

The Porte au Prince, Haiti earthquake of 7.0 Richter scale on January 12, 2010, that killed more than 230,000 people and razed almost the entire city to the ground to leave 1.5 million homeless[lxxvii], occurred without warning leaving dazed survivors wandering aimlessly through the rubble of their former city. The magnitude of this disaster taxed the capacity of foreign assistance of nations from all parts of the world. Aid straggled into Port au Prince without any prior plan of co-ordination. Dozens of foreign aid teams, working independently, set up medical centers, food distribution centers, and temporary shelter of various

kinds in sometimes-questionable locations. A temporary Haitian administration found no emergency plans and consequently it was decided that the already decrepit infrastructure of the existing city, along with new housing and other institutional and commercial facilities, would all be rebuilt, on the existing site of Port au Prince, at the exact location of the earthquake had occurred. More than any other occurrence in the first decade of the 21st century, the Porte au Prince disaster demonstrated the need for an emergency plan that would identify a safer permanent location upon which to rebuild Porte au Prince and a strategy to co-ordinate worldwide aid with a potential self-help labor resource prepared to undertake their own salvation.

Class 3 – Evacuations - Short term unanticipated disasters whose aftermath can be measured in days, weeks or months, such as minor earthquakes, volcanic eruptions and tsunamis, sudden weather occurrences such as hurricanes, typhoons and tornados, storm surges, floods and of forest fires. As in the case of Class 2 Instant Displacement, evacuation poses a major problem and the methods of escape are the same: purpose built multiple exits, an early warning system, a planned exit strategy and adequate refugee centers beyond the danger area, The quickness of an onslaught makes major casualties in densely populated urban centers inevitable and a quick recovery is dependent upon the length of time needed to restore essential services and infrastructure in the affected area. The type of aid in this class would be temporary and disaster victims would expect to return to their former locations. The far-reaching Indonesian tsunamis in the first decade of the 21st century that reached populated shores many hundreds of miles away and killed many thousands of unwary people remains a stark example

Class 4 –Attritions - multiple small-scale events whose final outcome and duration cannot be determined. These might include violent episodic or multiple disasters triggered by political, ethnic or religious motivated incidents such as terrorist attacks with conventional weapons, civil wars, and Jihads[lxxviii] that, through repeated events, attempt to wear down the resistance of their victims. The boundaries of large cities are porous and allow infiltration by extremists who can easily blend into the populace, making apprehension difficult. Settlements with smaller populations in which strangers are more easily noticeable can be more easily defended. The Palestinian Intifada[lxxix] against Israeli occupation of

the West Bank and Gaza Strip, beginning in 1987 is a classic example of attrition. An early and well-known terrorist group, al Queada, a militant Islamic fundamentalist group, founded in the late 1980s to combat the Soviet occupation of Afghanistan, has as its goal the establishment of a pan-Islamic caliphate and the expulsion of Westerners and non-Muslims from Muslim countries.

Class 5 – Pandemics – The outbreak of an infectious disease prevalent over a whole country or the world that is of varied duration. The most recent pandemic, the flu epidemic of 1917-18 killed millions of affected populations in Europe and North American and lasted 2 years.[1] Present restraints against pandemics are vaccinations cloned from the subject virus and by quarantine of infected populations either by sequestering them in isolated hospital wards or by quarantining the premises of infected residents. With, however, possibly thousands of infected inhabitants in a conurbation such precautions would be impossible to carry out.

If conurbations, cities, and towns could be broken down into smaller populations such as neighborhoods, the problem becomes somewhat more manageable but still need external sources to provide food and care. If broken down further into individual quarantined households within neighborhoods that conventionally have porous boundaries, watchful enforcement would be too sparse to ensure that infected individuals would not enter or leave quarantined premises or neighborhoods. In smaller self-contained self-sustainable and isolated settlements, community surveillance of quarantined households would be ensured and entry and egress from settlements more easily controlled. .

It is evident, in this survey of five classes of disasters, that residents of large urban centers are at a grave disadvantage compared to residents of smaller distributed towns. In addition to the inability to be quickly evacuated, a conurbation would be able to sustain itself for only a short period without external assistance. Without electricity to provide light and to run the pumps to supply drinking water, with no food except that in warehouses would only be enough for a very few days, making survival dubious. The alternative of smaller, physically detached communities with independent sources of food, water and energy sufficient can do all things necessary to make themselves invulnerable to a pandemic.

A novel method of disaster management in Thailand might be derived from their regionally based housing centers, where the rural poor come to obtain training and tools to build their own houses or communities. Sanctioned by the King of Thailand and established under the aegis of the Thailand Institute for Scientific and Technological Research (TISTR), these centers have been established in the poorer regions of Thailand. Using a construction system developed at the Asian Institute of Technology and the University of Hawaii[lxxx], the production and assembly of a modest, simple house, using local materials and techniques familiar to the trainees, is within the reach of the rural poor. Only manually operated tools are used to make the building components and these can be mastered by the trainee sufficiently to build a modest one room house in 1 to 3 days with basic sanitary water and waste management that is capable of re-assembly to suit changing needs from short term shelter to long term permanent housing, able to provide systems; able to use construction technology and tools that encourage learning while building.

In addition to providing hands on training to help the poor build better homes for themselves, TISTR could add the function of building disaster shelters by converting their national training centers into dual regional based training and disaster shelter centers. Mounting a disaster shelter program utilizing government resident trainers to also become the organizers of disaster shelter relief and the purveyors of disaster shelter building equipment expands the potential usefulness of the trainers. Knowing their regions and their people and, with their stores of training equipment for house building that can be adopted building disaster shelters on hand, resident trainers can quickly respond to disasters in their regions. Beyond the simple act of building disaster shelters lies the opportunity for disaster victims to, using centre facilities and construction system, expand their emergency shelters into permanent homes, followed by an improved urban infrastructure and eventually, a socially and aesthetically pleasing city,

Systemic Environmental Restorative Measures

As an alternative to the subterfuges and substitutions offered by technology to meet the consequences of global warming and radical climate change, Systemic Environmental Restorative Measures (SERM) relies solely on nature to restore the natural environment to a state that existed before the advent of industrialization. As a result, flora and fauna now irreversibly lost, leave human ingenuity to select suitable alternative species to restore, in these affected regions, an appropriate fit between human settlements and their environments.

Implementation will raise many issues; there will be questions, some political, some financial, some organizational, some scientific, some theological, and some philosophical that will be encountered. There will be crucial schedules to be met and changes to be made that may affect current life styles, possibly positively for the disenfranchised landless poor located largely in developing countries and possibly negatively for the enfranchised citizens in the developed countries.

Among the many aspects to be encountered is the perceived relationship between humanity and nature. As explained in deep ecology, one perception views humanity as part of the genome of all natural life forms including not only other animals but also all organisms, i.e. humanity is derived from and is a part of nature whose genes are shared by all life on earth. The other perception endows humanity with attributes that set it apart from nature which is perceived as a passive resource to serve the needs of humanity. The prevailing perception will obviously have a significant impact on the manner of application of Systemic Environmental Restorative Measures on the natural environment.

First steps toward implementing Systemic Environmental Restorative Measures have already been taken in the form of local conservation and environmental protection by government agencies and academic studies of only a very few countries and a feckless United Nations. To be achievable, it will be necessary for all national governments to elevate Systemic Environmental Restorative Measures to a cabinet or department level at least equal to that of their national defense cabinets or departments. The United Nations must also create a council equal in authority to that of its Security Council because both councils would be equally important to the survival of human existence. The skills necessary to move toward the goal of restoration reside largely within universities and include such an astonishingly large number of disciplines as to suggest the creation of a new discipline. In such cases, academic strategy would be to create a new doctorate program to signal an amalgam of the many disciplines from which a new discipline could evolve. There might also emerge levels of expertise at municipal, provincial, national, and international levels and geographically by aquatic and land specialties. Space colonization might also be added as a contributor to an alternative environment of a failed world environment that is no longer capable of sustaining human existence.

Systemic Restorative Measures

1. Restorative measures seek out the causes of environmental deterioration and devise strategies to neutralize them.
2. Restorative measures define methods to restore the balance of ecological processes that have been stifled by unnatural means.

3. Restorative measures require an understanding of the goals of deep ecology and the need to shun cosmetic and reactive approaches to environmental problems.

These goals may best be attained through an international bureau of scientists devoted to maintaining world environments at the proper temperature and with the proper constituents through an appropriate mixture of elements suitable for human survival. An example of urgently needed remediation is the excess of carbons in the atmosphere that threaten, through a blanket effect, to unhinge the range of temperatures and constituents suitable to organic life forms. The natural method to redress this imbalance appears to be at hand: immediately cease slash and burn in tropical forests because "[annual] deforestation represents about 15 per cent of annual greenhouse gas emissions – more than all the world's cars, trucks, planes, trains and ships combined [emit]"[1] If this is true then the obverse – replanting the same area of felled tropical forest would counterbalance for all the emissions of the worlds cars, trucks, planes, trains and ships, by restoring the climate to its former state – would also be true. The operative word in this simplistic hypothesis is replanting; a method that has already been proven effective "…evidence from Costa Rica and Panama shows that tropical forests can recover 90 percent of their original biodiversity in as little as 20 years."[1] and furthermore, "protecting and restoring…. forests is a much cheaper way to cut CO2 … than switching to renewable energy" [1]

An Alternate Path to Equity

One hundred years ago, rural workers and artisans streamed into London to seek employment in the new mass production industries to endure housing circumstances that are now being experienced by unemployed rural workers in the developing world. In the 21st century the same problem of housing rural migrants holds true, only now the problem is global and the magnitude in terms of population may be a hundredfold or more. Migrations of rural poor to urban centers in developing countries have created physical and social conditions that are at least as severe as those Howard observed in the slums of London. But, whereas the population in the slums of London in the 20th century were a relatively minor proportion of the urban population, slums today, composed of street dwellers that sleep on sidewalks at night, squatters who build illicit shacks on unoccupied land owned by others, or illegal occupiers of vacant built premises, account for more than half of total urban populations in many developing countries[1]. Of these, squatters, who are typically the preponderant group, will organize themselves to become 'invisible' communities scattered throughout and around cities largely in developing countries. Over time many of these communities of landless poor will replicate the governance, educational and social services of their civic counterparts and internally generate 'invisible' premises to conduct undocumented commerce and industrial activities to supplant the dearth of jobs available to squatters outside of their slums. These 'invisible' activities are estimated to account for 1/3 of the gross national product of many developing countries, were it to be counted along with the documented gross national product, reported annually to world economic organizations[1]. It is through measuring the gross national product that the economic viability of national economies is rated.

If the 'invisible' undocumented portion of the gross national product were to be included in the annual reporting, it would appear as a substantial increase in the annual gross national product (GNP) and would

result in a proportionate increase in the economic viability of the reporting country. Transformation from 'invisible' to 'visible' would also integrate the slums with their commerce and industry and their residents into formal members of civic society. Incorporation into, and acceptance by civic residents of newly 'visible' slum communities, with their industries and commercial facilities merged into host municipalities, could possibly be the next step. Squalid squatter settlements, however, would have to be upgraded to municipal health, safety, planning, and building standards[1] before incorporation into formal society could be accomplished. This would likely require preparing plans and creating completely new communities; an undertaking most developing countries, their cities and most certainly the slum dwellers themselves, could not afford.

There are however, noteworthy models to follow[1] in which slum dwellers, have initiated and contributed, through their active participation in □sweat-equity□, to upgrade their residential circumstances with the guidance and support of their local and national governments, housing banks and international and national non-government aid organizations. Upgrading and incorporation would give the slum dwellers full entry into the formal community and their industries and commerce would be registered, (and taxed) and with their upgraded real property, the creditability of an address and a bank account. Such □sweat-equity□ strategies are routinely employed by non-government organizations in their slum upgrading and housing projects in which slum dwellers contribute their labor toward the construction of their housing will, upon completion of the housing project, acquire equity equal to their proportion of labor in the housing project. The equity, now a piece of real property, is translated into documentation that is recognized by civic government and by financial institutions that record the name and address of the new owners thereby giving them full civic rights (and taxes) and a bank credit rating.

Adoption of this method by government, of entering into agreements with organized groups of slum dwellers to provide sweat-equity labor in specific housing projects that are under the supervision of non-government organizations or private developers and contractors will benefit all parties: government financing costs are reduced by subtracting a part of the labor component costs; NGO's will benefit from government support and access to land; private contractors will benefit from reduced financing charges, free labor, a fixed profit margin with sureties provided by government; and the national government will both reduce its public housing costs and acquire an increase in the national GNP. The strategy of hiring organized groups of itinerate or seasonal labor in construction projects is commonly practiced in many developing countries. In Thailand, construction contractors commonly enter into contracts with headmen of impoverished villages of Thailand, to provide specified numbers of unskilled and skilled construction workers and foremen from their villages to building projects in Bangkok: a formula that is adaptable to accepting equity in the form of a housing unit in lieu of a cash payment.

Chapter VII

The Embodiment of a 21st Century Garden Settlement

[lxxxi] *"To solve the great problem of the city for England is to solve it for all of Europe, America, Asia, and Africa" Ebenezer Howard 1901*

The ultimate goal of Ebenezer Howard was worldwide adoption of his economic, social and physical concepts[lxxxii]. These, in the 20th century guise of Victorian artifacts, governance, economics, and methods would today be utterly alien to many cultures. Evolutionary progressions of garden cities and regions into the 21st century must translate Howard's underlying concepts into systems and methods that give sufficient freedom for all cultures and nations to each pursue their own path toward the goal of a full measure of economic stability, social life and healthy environments. For this reason, regional and urban physical designs of Garden Cities are limited, as were those described by Ebenezer Howard, to be sufficiently abstract to enable viewers to envision the plan, design and construction of a garden city in terms of the milieu of their own cultural experience. Fictional perspectives and views of street scenes, building designs and city plans, prepared without an intimate knowledge of the target culture and building site characteristics and context, should be avoided because laypeople invariably interpret such drawings to be authentic representations of what is to be built which, if alien to the observer, may arouse negative reactions. Instead, familiarity of local planners, architects, engineers and builders with the idiosyncrasies of their culture, the local building materials and methods of construction and the flexibility that the Garden City concept and methodology encourages, should be utilized in the creation of their own version of garden cities and regions.

A Critique of the Garden City of Ebenezer Howard

The technique to carry out the creation of a Garden City for the 21st century is by an analysis and a critique of the original proposals of Ebenezer Howard in his book, *Tomorrow, a Peaceful Path to Real Reform* published in 1898 and by introducing additional precepts and elements and their operations to meet current conditions. By making these adjustments to meet the technical, demographic, socio-economic and cultural changes that have evolved over the past 100 years and to broaden the scope to meet the changing conditions confronting life on our planet, a specification for a garden city sensitive to the issues that confront humanity today is needed. Physical manifestations of the specifications, although they may share the functionality of a garden city, will vary widely: a garden city in arid Yemen could be completely different from a garden city in the rain forests of Malaysia; a high density garden city in the centre of Manhattan island in New York city would share little with a low density garden city nestled in the verdant rolling hills of rural northern Wisconsin .

Anomalies appear when attempting to compare the 19th century Garden City of Howard with a proposed model for the 21st century: the disparity of world human populations between the two periods requires a proportionate multiplier. The 32,000 population proposed for the Garden City of Howard in 1898 would have had a significant impact upon the local county council and the fabric of local society and environs whereas the construction of a subdivision in 2011 for a population of 32,000 in a conurbation

would pass almost unnoticed and the technology, in the form of machines and materials for building construction would literally be the difference between horse drawn excavation shovels and diesel powered bulldozers while the organic building materials of Howard's day might be largely supplanted by the chemically and metallurgically derived building materials of today.

Based on the 1898 version of the Garden City precepts in Howard's book, a critique, that follows the format and descriptions of their appropriateness or adaptability to present day construction and living standards, will be in the form of comments to correct shortcomings and to recommend improvements by a review of Howard's drawings and writings of the 20th century followed by their 21st century adaptations. This might reveal both insights and oversights not readily apparent in a casual appraisal of a 21st century model of a garden settlement. Together with the 1898 version of the Garden City precepts in Howard's book, a written specification of a 21st century version of a garden city, of similar size and with similar functions, that follows the organization in Howard's book, can be described.

Populations and Demographics

1898 *Except for the project described in Tomorrow, a Peaceful Path to Real Reform, with an urban population of 30,000 and a rural population of 2000, Howard made no mention, except in his references to Social Cities, of garden cities with greater or lesser populations.*

2011 As an alternative to conurbations, the 21st century garden settlement provides a simple but complete model that may be scaled, within functional limitations, upward for a larger population or scaled downward for a lesser population. An optimal population for a Garden City has yet to be determined but would likely be reached when the basic, simple methods of infrastructure can no longer serve the needs of the community, when the voice and vote of the individual citizen no longer is felt to affect the outcome of settlement governance and policies and when the individuals in a settlement can no longer walk and know the extent of their community and cease to feel a part of it.

In the interests of consolidation and homogeneity, the farmers and their families numbering 2000, might enjoy a better quality of life and schools or children within a garden city, while commuting daily to attend to their farms, thus increasing the total urban population to 32,000.

Taking Howard's standard lot size of 20 x 130 feet that equals 2600 square feet, and by multiplying this by the 5500 housing lots that Howard mentions in his text, yields a total area dedicated to building lots of 14,300,000 square feet. Dividing this total area by the planned population of his Garden City of 30,000 yields an area of 477 square feet of land per person. [lxxxiii] With the revised total population of 32,000, the total lot area required would be 15,264,000 square feet spread over four population residential zones to yield a lot area per zone of 3,816,000 square feet per Zone.

The multifarious life styles, now prevalent in the 21st century, require a greater variety of housing models. To account for this, a range of 25% each for building stories ranging from 4 to 1 stories is applied by dividing for each zone, commencing with Zone 1 that fronts on First Avenue by 4 floors to yield a total lot area of 954,000 square feet; Zone 2 by 3 floors to yield a total lot area of 1,272,000 square feet; Zone 3 by 2 floors to yield a total lot area of 1,908,000 square feet; Zone 4 by 1 floor to yield a total lot area of

3, 816, 000 square feet. This arbitrary and approximate method is intended only to aid in establishing preliminary design parameters. Local context, including economics, in situ and social aspects such as views and neighborliness, would determine the mix and dispersion of the various types of living accommodation to be built. As a general rule, the highest urbanity, density, value and number of floors, would likely be the residential zone closest to the Circular Mall and to then be progressively scale down in height to be one storey at the residential zone closest to the perimeter of the garden settlement. Such an arrangement would provide the opportunity, for living units in upper levels of multi-storey units, to enjoy a view outwardly toward the countryside or inwardly, an overview of the Circular Mall and the Common.

Functions and Facilities

1898 *At the very core of Garden City, as shown in Figure 4, is a central circular park of 5 ½ acres around whose periphery are located a town hall, lecture hall, theatre, library, museum, art gallery and hospital.*

2011. Missing from this list of possible civic institutions that that might be included, if population and scale merit, could include higher education such as an upper school and possibly a 2 year community college; recreational and physical health facilities, equipped with bleachers for spectator viewing of sports activities such as football, cricket, basketball, tennis, badminton, swimming, and gymnastics. Civic essentials such as town hall, police, ambulance, fire, security and emergency facilities could be provided within the Mall. To eliminate redundancies, facilities such as a lecture hall, theatre, library, museum and art gallery, along with the sport and recreational facilities would be shared among students, organized sports and the community at large.

The list of loosely placed civic buildings around the periphery of Howard's Central Park invites building "creep" in which future buildings may encroach into the park area[lxxxiv] and the arbitrary division into successive concentric central park spaces by Howard, should be consolidated into a single core space which would become the traditional Common whose perimeter would be aligned with the inner eave of a continuous canopy.

The Crystal Palace

1898 *Incorporating and encircling the core is the 145-acre Central Park that is, itself, encircled by the Crystal Palace, whose chief functions, in Howard's plan, are to provide shelter for commercial and social facilities during inclement weather.*

2011 The Crystal Palace was a cast-iron building originally erected in Hyde Park, London, England, to house the Great Exhibition of 1852. Howard obviously admired this structure and chose to emulate it as a central meeting place and commercial market in his proposed Garden City. A Crystal Palace however, might not be appropriate in terms of culture, climate, capital investment or complexity of construction that might most benefit a Garden Settlement. A more fitting name for this structure might be the Circular Mall.

The Circular Mall could be a continuous self-supported canopy, circumventing the Common and of such height as to leave a generous clearance for two storey free standing structures that might be built beneath the Mall canopy. There should be no floor to ceiling walls, partitions or continuous structures built

beneath the Mall canopy in order to provide maximum cross ventilation and to ensure unobstructed views through the Mall, between the Common and First Street. The continuous curving circular canopy could be V shaped to catch rainwater for storage in cisterns beneath the Circular Mall floor to support a communal drinking water system. On the edges of the V shaped roof, photovoltaic panels mounted on a Mansard roof whose angle of incidence would curve to follow the path of the sun to provide a source of electricity for municipal buildings sheltered under the Circular Mall.

Appropriate to population and scale, additional functions might be independently constructed and serviced under the Mall canopy such as civic functions and services including education, city hall, fire and police; commercial and business activities, including chain and big box discount emporiums as well as specialty shops, offices; restaurants and fast food courts to serve students, and employees of the civic institutions and commercial businesses, strategically placed around and bordering on the Common. For the public at large, live entertainment facilities within the Mall such as a public stage and spectator seating for outdoor sporting activities such as cricket or baseball with bleachers sheltered under the protection of the Circular Mall canopy and contiguous to educational facilities could also be included within the precincts of the Mall. Looking inwardly onto the Common would reveal students walking between classes or government workers on their morning break stopping briefly to watch a football game or, if opening outwardly onto First Avenue to invite casual strolling shoppers into the Mall.

In plan view, the Mall canopy could shelter clusters of loosely spaced buildings sharing common functions and facilities located around the entire circumference of the Mall, with shops, private offices, clinics, kiosks, and so forth facing outward side on to First Avenue. Facing inward toward the Common could be civic and institutional facilities such as a library, city hall offices and educational facilities with a covered campus and bleachers with their ancillary sports facilities of locker rooms and indoor sports. Some functions such as food courts, a space for public gatherings and a market would open onto both First Avenue and the Common to provide vistas and spaciousness and the benefits of cross ventilation.

The Residential Zones

1898 "*Encircling the Crystal Palace Mall is First Avenue that defines the border between Central Park and four bands of circular residential zones that are divided equally on either side of a 420 feet wide Grand (Third) Avenue; a broad avenue that functions as a public park as well as a circulation route to be, "… "within 240 yards of the furthest removed inhabitant…"*[lxxxv] *and into which may be inserted religious structures and primary "[lower]schools .and their surrounding playground and gardens"*[lxxxvi] *to serve each of the neighborhoods (wards,) that circumvent the complete circular city, thus ensuring close proximity between home and school. Residential zones on both sides of Grand Avenue are further divided by two minor avenues, Fourth and Second Avenues, into separate circular*[lxxxvii] *residential zones. Howard mentions various types of housing on variable lot sizes and specifies in another part of his description of residential housing a particular lot size measuring 20 feet wide by 130 feet deep, and "larger housing" fronting on 3 3rd Avenue. The self executed plan by Howard of a Ward , drawn to a very fine scale*[lxxxviii] *is, however, too small to manually draw a detailed plat showing the disposition of each lot, leaving the reader*

with no clear information on the intent of Howard to allocate or stipulate particular sizes and shapes of lots in particular locations.

2011. The major function of Third Avenue is actually that of a circular band of parkland nestled in the middle of the four residential zones. This division places residents much closer to their primary education schools located within Third Avenue that are assigned on the basis of one to each Ward, while social, recreational and religious facilities are randomly scattered throughout this park like setting. Pedestrian pathways, free of vehicular traffic, give children safe passage between home and school. This is a most commendable strategy that should be preserved and should be renamed Parkway rather than 3rd Avenue, by banning all vehicular traffic, except emergency and maintenance vehicles, from accessing the Parkway via Urban Corridor roads.

Accommodating rectangular buildings on non-rectangular lots, it appears, may not provide the most efficient use of urban space. Asymptotes present themselves when attempting to place rectangular lots and houses within radial and circular generated lot lines. When, for example, the economies of rectangular plan shape row housing are attempted, tapered sidewalls and curvilinear front and rear walls result if the flow of facades is to be maintained. The interior spaces thus generated might also prove too novel or visually disturbing to the general public. There are architectural precedents however[lxxxix], that have enthusiastically embraced this dilemma to produce or revive a vocabulary that may be more in keeping with some 21st century architecture and life styles. Lots fronting on boulevards however, as described by Howard, may have rectangular lots and housing.

It would be appropriate to adopt a more systemic approach, suitable to the gravity neutral and circular precepts, in the design of residential sub divisions in order to eliminate unsightly infrastructure such as overhead electrical and communication wires and to relocate underground utilities such as water, sewage, gas and oil piping from under street paving to a more accessible location. To this end residential lots and buildings would be served by a lane at the rear of each residential property which, in addition to providing access to the rear yards of each house or apartments would eliminate service vehicles on the avenues and, at the same time, provide a concrete enclosed submerged trench in the centre of the lane to carry cables, electricity, water, gas and sewage piping and to collect surface water drainage. Service vehicles would access the lanes to collect trash for recycling and to service via access portals in the trench the various utilities contained therein. Thus created, the lane becomes a seminal Urban Corridor that, for larger Garden Settlements, could also include public transport of goods and people.

To reduce the footprint of the settlement, the width of the circular bands of residential zones should be reduced and the building types be arranged so that the density, height and urbanity of the housing is greatest in the zone closest to the Circular Mall and to progressively diminish in height as the residential zones reach the industrial (Service) zone. This strategy would provide outward vistas to pastoral lands beyond the borders of the settlement to upper floor residents in each residential zone as the height of residential buildings step down in successive residential zones. Looking inward, residents in buildings fronting on 1st Avenue would overlook the Mall roof to capture views of the open spaces of the Common.

The Industrial Zone

1898. *The outermost circular band is the Industrial Zone (commerce, warehousing and light manufacturing) facing inwardly onto Fifth Avenue and outwardly onto the dedicated railroad siding that encircled his Garden City constitutes the Industrial Zone. Access to and from the Industrial Zone is through, according to Howard,*[xc] *portals [in walls] providing dispensing facilities such as shops fronting on Fifth Avenue and through which horse drawn and the newly invented internal combustion powered vans and lorries*[xci] *would pass to distribute goods throughout Garden City or, conversely, to collect goods for delivery to distant destinations and, on the outward side, goods manufactured in or transferred through the Industrial Zone would benefit from direct loading and unloading of freight carriages parked on the encircling railroad sidin*g.

2011. Of all the facets of Howard's design of his Garden City, none are so affected by changes in the 21st century as the industrial zone. As a result of global warming, energy generated by carbon based sources such as coal and oil, the basis for the original industrial revolution, are being replaced by 'sustainable' energy sources such as sea, wind, natural gas and sun and, as yet to be perfected, small nuclear and hydrogen fuel cell sources, to produce carbon free electrical or mechanical energy to power machinery, vehicles and to assemble a built environment. This will require a complete rethinking of the functionality and parameters of the industrial zone that would now also incorporate the functionality of the new element of nodes. Another troubling aspect of the industrial zone is the degree to which inhabitants of a garden city are visually, as well as physically, separated from the surrounding natural environment of Agricultural and Preservation zoned lands and the need to re-establish this connection.

Railway sidings to serve industry and human settlements have now been largely supplanted by internal combustion powered vehicles, some of which are quite large semi-trailers, capable of carrying very large and heavy loads. In this transition period of changing energy sources, vehicles of this type may remain essential for some time and will continue to be a significant hurdle to overcome when attempting to accomplish a delivery inside a settlement. According to the Land Use code herein, Garden Settlements lie within a Green Line Zone that prohibits the presence of engines emitting particulates and carbon dioxide. All such vehicles must be parked outside the Green Line and goods and passengers must pass through the Green Line either on foot, be carried by a non-internal combustion vehicle or be moved on non-polluting mechanized transport. Provision to accomplish this is provided by Nodes located at the juncture of boulevards and the Green Line that circumscribe the settlement. In this instance Nodes act as screens to ensure that no vehicles emitting particulates and carbon dioxide pass through the Green Line.

Fifth Avenue, that separates Residential Zone 4 from the Industrial Zone, appears to be inadequately protected from industrial noise and activities that might spill over onto Fifth Avenue to annoy residences fronting on Fifth Avenue. Less annoying activities such as warehousing and printing shops could continue but heavy, noisy, or noxious activities must be removed to self-contained extensions of Industrial Nodes that are located outside the Green Line. Howard's outermost zone could then be transformed to a Service Zone to provide warehousing and vehicle parking functions within the confines of designated Nodes,

leaving the interstices between Nodes limited to low landscaped garden walls to provide residents with natural vistas of the agricultural greenbelts.

The Perimeter Road

1898. *Beyond the Industrial Zone Howard provided a bounding railway siding connected to a main line that would provide prompt and frequent service to meet the needs of the people and their productive and commercial activities through warehousing as well as passenger station to provide service directly to London.*

2011. With the advent of the internal combustion engine to power cars, buses, vans, trucks and lorries, the bounding railway siding proposed by Howard is replaced in the 21st century by a bounding Perimeter Road, that functions exactly like a one way round-a-about or traffic circle to allow traffic to enter or exit Service Roads to reach the Agriculture Zones via dead end rural roads and Residential Zones within the Garden Settlement via Nodes. Garden Settlement residents, with internal combustion powered vehicles, may have reserved parking stalls within the Node nearest their residence, while visitors may park at a Node closest to their destination in stalls reserved for this purpose. Special destinations such as airports and harbors would fall under the purview Garden Region administration to link Regional Corridors to Garden Settlement Perimeter Roads,

The Green Belt

1898 *To prevent external encroachment and internal expansion of urban development, Howard proposed, as his most external zone, a "green belt" of agricultural and rural lands, to circumscribe Garden City. Comprising 5000 acres with considerable depth, Howard appended to his list of agriculture and reforestation activities, a considerable number of socially oriented programs including Children's Cottage Homes, Convalescent Homes, an Asylum for Blind and Deaf and an Agricultural College. These worthy social and educational programs would require housing, laboratories, classrooms and clinics and concomitant facilities for faculty, medical, special needs, clerical, management and maintenance staff. Access to these facilities and activities, storage for agricultural implements and produce, workshops for maintenance of buildings and equipment and the institutional facilities themselves, would require a complex of roads, many of which might breach the green belt by having direct access to external county and national roads. These multifarious activities would abrogate the primary purpose of the green belt: a stabilized population surrounded by fixed rural land*.

2011 In the peaceful world of Victorian England, surrounding proprietary rural lands would be deemed to be sufficient to provide security but, with no mention by Howard of secured enclosure in *Tomorrow, a Peaceful Path to Real Reform,* would result in a porous boundary that, in many parts of a 21st century world, would invite the loss of land, crops, livestock and unsecured goods, tools and machines by invasions of wild and feral animals, squatters and homeless migrants from distant lands[xcii]. In these extreme circumstances, Garden Cities would require more secure tactics to counter these exigencies such as a division of the green belt into Inner and Outer Agricultural Zones to provide more security.

The Outer Agricultural Zone, defined possibly by electrified fencing at the limits of the garden settlement property line would discourage incursion and give warning, as a first line of defense against unlawful entry. Dedicated solely to agriculture allotments of commuting farmers who live within the Garden Settlement and defined by the type of terrain and soil to determine what would be the most appropriate crops or agricultural activity such as grain or grazing lands, reforestation or preservation, would be carried out in this zone.

The Inner Agricultural Zone, also defined by an outer perimeter fence, would consist of intensely cultivated, heavily fertilized and watered "market garden"[xciii] type of cultivation and the raising of fowl and small animals by farmers resident in Garden City and by "victory gardens"[xciv]style allotments, cultivated by private citizens of Garden City. These must be of sufficient scale to, in peaceful times, provide a livelihood for farmers and a healthful supplement of organic foods to the diets of private citizens and, during times of emergency to provide, for the population of Garden Settlements, a sufficient and balanced supply of foodstuffs for an indefinite period of time. Because farmers and citizens would regularly work their farms and gardens in both Agricultural Zones, their intermittent and staggered presence would itself constitute an early warning system to alert Garden City residents of surreptitious pilfering or of impending invasions of squatters that typically squat on the fringes of cities.

Internal Circulation and Transportation

1898. *Starting at the Central Park, six boulevards at 60-degree interval radiate outward to be intercepted, at regular intervals by five circular avenues. Beyond the last avenue, and marking the border between urban and rural lands, is the railroad siding, Figure 4 shows that certain boulevards extend from the Garden Centre straight through Garden City, the Railway Right of Way and the Agriculture Zone green belt to connect to National and County road systems thus reducing the effectiveness of the green belt as a barrier to unauthorized entry into the garden settlement. Two of the six Boulevards, cut straight through the Agricultural Zone with no indication of control of traffic entering or leaving the green belt and with apparent grade level crossings over the railroad siding. A third boulevard also cuts through the Green Belt but, at the intersection of boulevard and railway siding, a notation "Bridge" suggests an overpass over the railway siding. At the intersection of a fourth Boulevard with 'Main Line Railway' appears the notation' Railway Station '. Altogether, four of the six boulevards, effectively cut the Agriculture Zone green belt into four discrete sections that would conflict with the network of roads necessary to service the institutions, their ancillary facilities and the agricultural activities located in the Agriculture Zone green belt,*

Howard's circular plan of Garden City, because of its orderly forms, clearly defines, from its innermost core to its outermost perimeter, the zoning of functions by circular bands that are strategically arranged to facilitate daily routines and omni-directional paths to arrive, on foot, at desired destinations by the shortest route i.e., a resident that worked in the Industrial Zone would likely choose to live in a house fronting on 1st Avenue enabling him to simply walk across the avenue to reach his place of work. Other modes of movement throughout Garden City are not described but would have likely included

wheeled vehicles commonly pulled by horses and a smattering of "horseless carriages" with internal combustion engines that, in this early stage of development, would already be emitting noxious fumes. The manner of movement of goods delivered from the parked railroad goods carriages[xcv] *on the dedicated railway siding, through the Industrial Zone warehouses for distribution throughout a garden city was to be via portals and shops fronting on 1st Avenue, is not described.*

2011. It is to Howard's credit that he chose to place the Mainline Railway Station at the periphery of Garden City and not, as is still the custom, in the city commercial centre. That would have corrupted the geometry of Garden City and inevitably divided the city into two parts. It is also to Howard's credit that the outermost zone was reserved for industry and commerce that, through a dedicated circular railway siding, would reduce the handling and travel necessary to distribute or collect goods and for workers in the zone to live in residential zones close by their place of work. If however, a worker's dwelling was in a residential zone diametrically opposite to his place of work in the Industrial Zone or if a resident, intent on reaching the train station lives in a domicile that is diametrically opposite to the train station, both worker or traveler would be required to cross to the opposite side of the circle to reach their destination, a distance of around 1 and ¼ miles.

To meet the Green Line prohibition, as applied to Garden Settlements, of no internal combustion powered buses, trucks and automobiles allowed within Garden Settlements leaves modes of transportation of people and goods limited to bicycles, hand pulled or pushed buggies or carts, and small golf cart type vehicles powered by electric motors and, in larger Garden Settlements, a simple, light rail electric motor driven system. Regional Corridor transportation systems would be sophisticated light, high-speed rail similar to municipal mass transit system to enable quick, casual transportation of goods and people between Garden Settlements within a Garden Region,

Housing and Density1898.

The plan of the Garden City proposed by Howard is a perfect circle of 1-½ miles diameter located on a flat site. In his plan Howard calculated 5500 housing plots[xcvi] *to house 30,000 residents in a space of 1000 acres to yield a density of approximately three residents per acre*.

2011. It seems, from his calculations that Howard was planning to build either detached or attached single-family homes for his Garden City. Today, life styles have changed, at least in developed countries, and the single-family house is no longer the dominant form of housing. There are now singles or bachelor units (for both sexes), single parent households, a mobile cum transient population on short term leases, traditional detached single family and a revival of extended family compounds and attached multi-generation housing. The range of housing must be correspondingly varied which invites a study of how to arrange such a variety of housing both socially and physically within the rigid confines of geometric bands of residential zoning.

In addition to the consideration of building typologies, the thought that the smaller the garden city footprint, the less the impact on the environment and the more feasible pedestrian traffic becomes. Exploring the means to reduce the 1 ½ mile diameter Howard's Garden City to a lesser diameter while still

retaining the same population of 32,000 would increase the feasibility of pedestrian traffic and the use of small electrically powered vehicles for goods and people transportation, at the price of increased density, should be considered.

New Precepts and Elements for the 21st Century

Gravity Neutral Garden Cities and Regions.

1898. *Other than enjoinments by Howard to Unwin and Parker that " Garden City is to be consciously planned. There is to be an overall plan, already suggested in Diagrams 2 and 3-modified, to fit local geography " (see also endnote 36).*

2011. The origins and many benefits of the technique of aligning all built environments to a common level are discussed in Chapter III, 21st Century Precepts as is the selection of a common level for all the built environments of a garden settlement or within each coterie of Garden Settlements. In spite of the fact that a site judged to be suitable for a settlement is nominally flat, local minor changes in ground variations can occur over the extent of the footprint of the planned settlement. In the context of surrounding terrain, this is solved by selecting the highest point within the footprint to be the permanent benchmark for the lifetime of the settlement. The tops of all concrete footings, paved surfaces and organically cultivated areas in the settlement will be aligned, after taking into account surrounding grade levels with respect the highest recorded flood level, to this benchmark while the bottoms would extend to various depths to reach bearing adequate soil bearing capacity.

Bundling Utilities and Services

1898. *Infrastructural utilities and services were adopted at various times and in various parts of the world to result in various forms of utilization and manner of civic management. Non-standardization has resulted in chaotic and inefficient operations with no hope of eliminating redundancies and of ever reaching uniform standards of design and operation. The result can be seen in the implementation of electrical power by festoons of wires draped on various types of poles, of buried and frequently exhumed pipes for repair and monumental constructions to resolve urban transportation that have all invoked the tyranny of infrastructure over spaces traditionally reserved for human use.*

2011. Both at settlement and regional scales, ease of accessibility for maintenance and repair, the economies of shared initial construction costs and consolidating multiple rights of way are the defining reasons for bundling utilities and services that, if the gravity neutral mode is invoked, can include auto-processing and storage functions. By bundling utilities and services the blight of electrical wiring, poles and towers, inaccessible buried piping and tunnels are removed and, by channeling bundled utilities and services to flow directly between Garden Settlements whose initial installation and maintenance expense would cost less than attempts to rationalize the incorrigible chaos of present infrastructural installations. The Urban Corridor is the Garden Settlement version of bundling that can include such practices as using wastewaters as the principal means to fertilize commercial market gardens. Invasions into human space, however, continue in the 21st century, as windmill 'farms' with huge blades mounted on tall steel towers

stretch across the country and sea sides to add visual blight to already scarred vistas, while existing electrical 'hubs' and 'grids' to send out even more wire tentacles across rural landscape.

The Common

1898. *A fundamental and unifying urban element of great importance to the wellbeing and social aspects of human settlements that has been in use since primeval times and are still extant throughout the world. Howard's Central Park is an urbanized version of the historic medieval common whose functions and size varied according to the perceived needs of the settlement. For want of a better reference the area of Howard's Central Park is retained with the proviso that no structures with roofs will be built therein and the density should be low enough to avoid a sense of overcrowding.*

2011. The distinguishing element of a circular Garden Settlement is the centrally located Common, so called because it is the element dedicated to providing a space mutually owned and equally accessible to all citizens of a settlement. In its most fundamental form it is an unkempt space of undisturbed natural flora and, sometimes fauna, changing its landscape according to the desires of the settlement. Other than toilets without roofs and footpaths with water permeable surfaces, no permanent improvements can be made within the Common leaving it primarily a recreational space suitable for individual activities such as kite flying, family picnics, and for communal activities such as festive gatherings. Courts, fields, and pitches for various sports and games can be permitted providing they are contiguous to the inner side of the Circular Mall to enable the public and students to enjoy and to watch festivals, games, and sporting events.

The Node

1898. *Historically nodes in human settlements connoted confluences of caravan routes where travelers and traders gathered to trade goods and exchange information and to, over time, become cities and sometimes civilizations. In these instances, nodes may arise at the intersection and conjoining of two or more functions or points of transmission of human interaction.*

2011. In a Garden Settlement context modes perform many functions, the most basic of which are the transmission into and out of Garden Settlements of people and goods and of station stops on public transit systems. Additional functions of Nodes are as neighborhood centers replete with shops, as access points for entry to dedicated municipal activities of recycling, sewage, salvaging, industrial parks, access to Regional Corridors, water purification plants, as a parking facility for vehicles of residents and visitors with internal combustion engines that cannot enter a Garden Settlement, access point to maintenance facilities for public vehicles and systems and security screens in times of emergencies. Nodes can also have secured extensions to house heavy industries that must be located outside the perimeter of Garden Settlements Green Line.

Sustainability, **Security and Autonomy1898**. *In a world not yet a global community and without quick, convenient travel or communication, in a secure and prosperous England, exigencies, other than those of natural origin, would likely have seemed to be a remote possibility.*

2011. Today, communication is almost instantaneous and travel, both overt and covert, between nations and continents is virtually uncontrollable, bringing to the very doorstep of a sedate England, subversive

elements bent on the destruction of traditional, civilized societies. In other parts of a now over populated world that has squandered much of its agricultural land and ignored the omens of climate warming and rising oceans, food shortages and a shrinking land mass may provoke starvation and invasions by populations of secure and fertile lands. It is advisable to assist such afflicted populations in their own homelands rather than allowing them to become displaced and a destabilizing threat to the world.

Garden Settlements and sub-units such as Neighborhoods must be capable of self-sufficiency so that they can sustain themselves through periods of natural disaster or manmade duress. To apply this criterion, the regional context of a garden settlement must first be assessed to determine if water, energy and agricultural resources are available. Within tropical regions with fertile land, there is usually a seasonable abundance of water, the surplus of which can be stored in cisterns and in covered ponds to provide for human sustenance and agricultural purposes. In arid zones where water is scarce, the capability through Regional Corridors, to move vast quantities of water from flood zones to desiccated zones or regions, should be considered. Techniques in water management practiced in Israel by the Kibbutzim should also be considered.

Communal natural energy sources, usually windmills, small water falls and photovoltaic panels may soon be complemented by compact hydrogen cells and nuclear energy sources. Production of energy could be connected among neighboring Garden Settlements in a Social City to supplement or share loads over peak periods but should always maintain sufficient capacity for essential services over periods of emergencies.

Mutual security in isolated locations may be limited, requiring remote Garden Settlements to have secure contact, via Regional Corridors, with the nearest Garden Settlements in a Garden Region. Isolated Garden Settlements should also maintain a volunteer police force, a fire brigade, a militia and a well stocked and manned volunteer medical corps and clinic.

The Boulevard

1898. *By naming his radiating roads boulevards, Howard may have had in mind those Boulevards associated with Baron Hausmann, who remade Paris into a model western city by reordering the alignment of the central of part of the city to include broad, tree lined streets or boulevards under which were navigable sewer tunnels to carry human waste to the Seine River.*

2011. The Boulevards in Howard's Garden City plan are, in his circular plan, also broad tree lined roads that radiate from the Common to the outermost boundaries of the Garden Settlement. Boulevards can also function as social malls that provide pedestrians opportunities to pause at kiosks along the way to Nodes to enjoy refreshments and encourage social, recreational, and small-scale commercial activities.

The Urban Corridor

1898. *While Howard appeared to be aware of the importance of what is now called urban infrastructure, he notes it's existence only in passing when referring to having sewers to carry human waste to farmers for use as fertilizer and in the costs of providing and maintaining roads and sewers in his financial*

calculations and in his comments regarding the wear and tear on road surfaces that must carry heavy loads of goods between the Industrial Zone and the Wards.

2011. Fundamental to the separation of urban human space from urban infrastructural space, the Urban Corridor collects all utilities, services, transport of goods and people and liquid and solid wastes into a single linear corridor that maintains a continuous circular and gravity neutral path that can never be, in major scale projects, at the same level as pedestrian traffic. Its constituents are the same as those of a Regional Corridor to which the Urban Corridors of every Garden Settlement are connected via Nodes, to enable the exchange of similar constituents between Urban and Regional Corridors. This ability facilitates vertical exchanges of goods, people, communication cables, electronic cables, liquids and gases between Garden Settlements and Garden Region and lateral exchanges between Garden Settlements within a Garden Region. This is accomplished by providing similar transmission routes and mechanisms for the movement of goods and people, switch breakers for communication and electronic cables and valves for the transmission of liquids and gases. High density areas such as Social Cities, will generate sufficient volumes of traffic to have passengers transferred via time calibrated, electronically controlled inter-nodal high speed train systems to enable passengers to step off a train onto a station platform of a Garden Settlement, walk across the platform to board another train to move laterally to the next Garden Settlement or to move vertically to a Regional Corridor to reach a Garden Settlement in an adjoining Garden Region. This method of interchange will enable the casual and quick movement of passengers between Garden Settlements, between Garden Settlement and Garden Regions and between Garden Regions within a continent.

Epilogue

Tracing the saga of Garden City, that has unfolded over the past 100 or more years, has revealed a myth, a transgression, a clear choice between two utterly different garden city futures and a hint of chicanery to end in this resurrection of the original Garden City of Ebenezer Howard. The myth, a tacit ploy to associate Ebenezer Howard with Letchworth, the garden city designed and built by architects Unwin and Parker has been institutionalized by generations of scholars and pundits at the expense of giving credit to Howard for his own design in *Tomorrow, A Peaceful Path to Real Reform*, in which he had divined the merits of a circular city and had the courage to present them in his book for public scrutiny. There were a few who grudgingly took his circular city seriously; the London Times, October19, 1898 commented "…ingenious and rather entertaining attempt, the only difficulty is to create it." The majority, however, chose to assume that Howard's drawings and descriptions were diagrams.

The transgression occurred when the First Garden City Company, founded to implement a garden city and whose officers were prominent, reputable and staid figures of society, selected Unwin and Parker, both subscribers to the reactionary Arts and Craft movement of their time, to be the architects to design and oversee the construction of the garden city of Letchworth. After this decision, there is little mention of Howard except in connection with the garden city design of Unwin and Parker, a version that erased every vestige of the design by Howard of the Garden City in his book, *Tomorrow, A Peaceful Path to Real Reform,*

The choice occurred at the moment, when Howard's peers thoughtlessly set aside his plans for Garden Cities and Social Cities to substitute those of Unwin and Parker setting the world on a path that has led to the present state of almost universal urban malaise. Regular visits between English and American planners, over five successive generations, the latest of whom call themselves New Urbanists, have led to truncated reproductions of the Unwin and Parker versions of a garden city. None of these were fully successful but the very flexibility of the amorphous city borders, coupled to indeterminate street patterns and lot shapes, gossamer green belts and conflicted zoning incorporated in the Unwin and Parker version of a garden city, became the tools utilized to spawn the ubiquitous sprawling suburbs of the 20th century, initially in Europe and America and ultimately throughout urban centers of the world. This flexibility enabled the often imperceptible but implacable encroachment of sub-divisions into rural hinterlands bordering conurbations in which even the most distant of land parcels or the most minute pockets of by-passed lands could be quickly enveloped or infiltrated by this most adaptable planning technique. The rapid and worldwide adoption of the methodology of Unwin and Parker, propelled by publicity generated by the urban plan of Letchworth popularly called Garden City, quickly established this planning method in Briton, Europe, and America and ultimately, the industrialized and developed world.

Prompted by the hint of chicanery in the 1946 edition of Howard's *Garden Cities of Tomorrow*, edited by C. B. Purdom, contained an assertion added to the original body text and also scribbled across the faces of Howard□s illustrations in broad ink strokes that these were merely diagrams, suggests that these may have been put forward to offset the possible notion that a more enlightened public of the 20th century, unlike that of the stultified 19th century, were more likely to accept the notion that Howard's circular city were more than mere diagrams.

While this research has produced no 'smoking gun', there is sufficient ambiguity in the literature to give equal credence to the hypothesis presented in this work: that the Ebenezer Howard version of a Garden City could have been and would be a viable solution for the 20th and 21st centuries respectively. Through the pragmatism of Ebenezer Howard his "practicability" distinguished his precepts from those of his contemporaries that were deemed to be too utopian by the general public. Garden Cities thus defined, are more than just an alternative to conurbations: they are an opportunity to fit our settlements into our environments in ways that will make us aware of the sensitive relationship between manmade and natural environments; to rediscover the meaning of community; to build shelter that provides for all our human needs and no more; to rise to a level of perfection that will enliven our way of life and ensure our survival on a planet whose future appears to be uncertain.

Endnotes

[i] Republished with annotations in 1902, 1946 and 1965 as Garden Cities of Tomorrow.
[ii] Ebenezer Howard, Tomorrow, A Peaceful Path to Real Reform, Swan Sonnenschein & Co. London, 1898. "…my scheme is a combination of three distinct projects which have, I think, never been united before. These are: "(1) the proposals for an organized migratory movement of population by Edward Gibbon Wakefield and of Professor Alfred Marshall; (2) the system of land tenure proposed by Thos. Spence and afterwards (though with an important modifications) by Mr. Herbert Spencer; and (3) the model city of James Silk Buckingham. "
[iii] The 3 magnets illustration may also have been an original creation by Howard. His simple allegory, in his publication 'Tomorrow, a Peaceful Path To Real Reform' describes this phenomenon in terms of two magnets: populations driven to choose between a rural or an urban existence. To this dichotomy, Howard introduces a third magnet: an urban existence within a rural context: a city embedded in the countryside.
[iv] Ebenezer Howard, Garden Cities of Tomorrow, "The Garden City Idea and Modern Planning", an Introductory Essay by Lewis Mumford, MIT Press, Boston, 1946 ed., pp 29-40
[v] 'corridors' in this instance refers to conurbations, cities and towns loosely connected together between two hubs, e.g. "the corridor stretching from Boston to Washington,DC"
[vi] A generic term that categorizes cities, towns, villages and hamlets by population size and seeks to reduce or eliminate visual and functional preconceptions of each category.
[vii]Eugenie L. Birch, " Five Generations of the Garden City: Tracing Howard's Legacy in Twentieth-Century Planning" in From Garden City to Green City: the Legacy of Ebenezer Howard. Ed. By Kermit C. Parsons and David Schuyler (Baltimore: Johns Hopkins University Press, 2002) pp.171~200. The Garden City plan of Unwin and Parker traced up to the New Urbanism movement of the 21st century.
[viii] Margaret Catley-Carlson, Habitat Debate, "Why We Must Invest in Urban Water and Sanitation", 2000-Vol. 6 No.3
[ix] United Nations Centre for Housing (Habitat) Table A-1, Size and Growth of Total Population
[x] …in 1956, Frank Lloyd Wright [proposed] mile high tower [on a] Chicago lake front site [with]500-plus floors [for]100,000 people. (WBEZ,Aug. 25,2011), and the Ville Radieuse of Le Corbusier published in published in 1935 consisting of concrete high rise housing blocks laid out in long lines.
[xi] The rapid development of industry that occurred in Britain in the18th century, brought about by the introduction of machinery. It was characterized by the use of steam engines, the growth of factories, and the mass production of manufactured goods.
[xii] Peter Hall, Dennis Hardy and Colin Ward, 'Tomorrow, A Peaceful Path to Real Reform, Original Edition with Commentary, Routledge, NY 2003 p.21 "A deep agricultural depression, resulting from a series of poor harvests and intense overseas competition following the opening up of new land in the Americas and Australia reduced cereal acreage in England and Wales by no less than a quarter between 1879 and 1900 ."
[xiii] So named after the British monarch , Queen Victoria who ruled the United Kingdom of Great Britain and Ireland from 1837 to 1901.
[xiv] Peter Hall, Dennis Hardy and Colin Ward, 'Commentators' Introduction' Tomorrow, A Peaceful Path to Real Reform, Original Edition with Commentary, Routledge, NY 2003 pg. 3 "There was a huge drift of farm population from the rural districts into the capital, which grew at great speed. London added nearly one million to its population each decade between 1871 and 1901, nearly doubling [London] from 3.9 to 6.6 million."
[xv] Living conditions for the working poor in London during the Industrial Revolution are poignantly described by George Bernard Shaw in 'Pygmalion' and in the books of Charles Dickens, particularly 'Oliver Twist' that was later adapted to the cinema production, 'Oliver', which authentically portrayed these abject living conditions.
[xvi] John Ruskin (1819 – 1900) is best known for his work as an art critic, writer, and social critic whose essays on art and architecture were extremely influential in the Victorian era. 'The four essays that make up John Ruskin's attack".. on laissez-faire economics and Victorian business ethics' and William Morris (1896) was an English architect, furniture and textile designer, artist, writer, and socialist associated with the English Arts and Crafts Movement.
[xvii] Peter Hall and Colin Ward, 'Commentators' Introduction' Tomorrow, A Peaceful Path to Real Reform, Original Edition with Commentary, Routledge, NY 2003 pg. 5. ". There was the movement [Arts and

Craft] led by William Morris and John Ruskin (that were enthusiastically embraced by the architects Raymond Unwin and Barry Parker who were ultimately chosen to execute the design and construction of the prototype Garden City, Letchworth), rejecting industrialism and advocating a return to craft production and a sense of community."

[xviii] The Arts and Crafts Movement began in the 19th century as a reaction to the "soulless" machine-made production of the Industrial Revolution. Considering the machine to be the root cause of all repetitive and mundane evils, some of the protagonists of this movement turned entirely away from the use of machines and toward handcraft.

[xix] Peter Hall, Dennis Hardy and Colin Ward, 'Tomorrow, A Peaceful Path to Real Reform, Original Edition with Commentary, Routledge, NY 2003 p.6 "Howard began with his Three Magnets diagram. Like the other [diagrams]….Howard apparently drew them himself,.."

[xx] Peter Hall and Colin Ward, 'Commentators' Introduction' Tomorrow, A Peaceful Path to Real Reform, Original Edition with Commentary, Routledge, NY 2003 pgs 3- 4. Significant material from which Howard drew inspiration for his book included E. G. Wakefield who advocated "planned migration and colonization" as a means of securing land for the poor; Thomas Spence in one of his tracts argued "every individual parish should become a corporation and seize its rights to its land, which had been usurped by landlords, in collectivity; rents would henceforth be paid to them, to be used for public purposes like building and repairing houses and roads. These rents would produce a surplus for distribution to the needy and social expenditure. His ideal community would be regulated by a board of directors elected from and by the shareholders."; Edward Bellamy's Looking Backward' from which the notion of a 'socialist community' was derived; Peter Kropotkin's Fields, Factories and Workshops, which 'presented a vision of industrial rural villages based on electric power'; William Light's plan for the capital city of Adelaide, with the notion that once a city had reached a certain size, planners should halt its growth by a green belt and start a second city…' and 'James Silk Buckingham's plan of 1849 for a model town included many features [Howard] used in his Garden City diagram: limited size, a central place, radial avenues, peripheral industries. a surrounding greenbelt; and the notion of starting further settlements'". 'The arrangement of the buildings in concentric squares, places the residences of the working classes nearest the green fields, on the immediate edge of the Town, which is favorable to their health, and, being close to their workshops, is also favorable to the economy of their time and labor.' .

[xxi] Peter Hall and Colin Ward, 'Commentators' Introduction' Tomorrow, A Peaceful Path to Real Reform, Original Edition with Commentary, Routledge, NY 2003 pg 7. "Howard did not limit his vision to haphazard multiplication of Garden Cities. At the root of his vision was the notion of 'Social City' consisting of a polycentric cluster of Garden cities, connected by rapid transit, housing a population of 250,000 on 66,000 acres, which 'could proliferate almost without limit until it became the basic building form covering most of the country.'

[xxii] Ebenezer Howard, Tomorrow, A Peaceful Path to Real Reform, Swan Sonnenschein & Co. London, 1898. P.13

[xxiii] Peter Hall, Dennis Hardy and Colin Ward, 'Tomorrow, A Peaceful Path to Real Reform, Original Edition with Commentary, Routledge, NY 2003 p.33. "Garden City is thus a model of urban compactness : circular in form, it has a radius of only three-quarters of a mile (1.2 km) from centre to edge".

[xxiv] An unsecured loan certificate issued by a company, backed by general credit rather than by specified assets.

[xxv] Ebenezer Howard, Tomorrow, A Peaceful Path to Real Reform, Swan Sonnenschein & Co. London, 1898. P. 13 "The essential feature of this plan is that all ground rents, which are to be determined by competition among the tenants, shall be paid to the trustees, who, after providing for interest and sinking fund, will hand the balance to the Central Council of the new municipality to be employed by such Council in the creation and maintenance of all necessary public works – roads, schools, parks, etc."

[xxvi] Peter Hall, Dennis Hardy and Colin Ward, 'Tomorrow, A Peaceful Path to Real Reform, Original Edition with Commentary, Routledge, NY 2003 p.53. "…rate rents….consists of three separate elements. First is 'landlords rent', actually the payment of interest on the money borrowed to buy the land and build Garden City. Second is the 'sinking fund', the replacement of the principal. And third is the 'rates' collected to support municipal services, as in any conventional local authority."

[xxvii] Ebenezer Howard, Tomorrow, A Peaceful Path to Real Reform, Swan Sonnenschein & Co. London, 1898. P. 18

[xxviii] Scrawled notes in later editions that appear to have been hastily added to Howard's drawings, indicating that his drawings were merely diagrams and not to be followed in the actual construction of Garden Cities. There are no such notes on the drawings of the original 1898 edition leaving the question of who added the notes to later editions unanswered.
[xxix] Inspired by a contemporary all glass and cast iron structure built for a world exposition held in London to herald the arrival of the Industrial Revolution in Great Britain.
[xxx]Otherwise known in North America as 'railway freight cars'.
[xxxi] Howard expresses his view on liberal economic reform.
[xxxii] "probably destined to become greatly enlarged" appears to contradict of one of Howard's most firmly declared precepts: that Garden City populations were to be firmly fixed.
[xxxiii] Peter Hall and Colin Ward, 'Commentators' Introduction' Tomorrow, A Peaceful Path to Real Reform, Original Edition with Commentary, Routledge, NY 2003 pg 5. "In the famous ending of Chapter XI, .. ' A Unique Combination of Proposals', bringing together the proposals for organized migration from Wakefield and Marshal, the system of land tenure derived from Spence and Spencer, and the model city forms of Buckingham and of Wakefield as interpreted by Light. By bringing them together, Howard believed he had found the solution."
34 This summation of the functional and spatial aspects captures the essence of the Garden City of Howard.
35 A reaffirmation that Howard held true to his conviction that planned Garden Cities should be fixed in size and circular in shape.
[xxxvi]Lewis Mumford,' The Garden City Idea and Modern Planning', an introduction to the 1946 edition of Ebenezer Howard's Garden Cities of Tomorrow, MIT Press, Cambridge, Mass. p.32 "When Messrs. Unwin and Parker came to design Letchworth itself, they perhaps leaned over backwards, in their effort to avoid mechanical stereotypes, in order not to duplicate Howard's diagrammatic city. Unwin's love for the rambling layout of medieval German hill towns was even in some degree at war with Howard's rational clarifications and forward-looking proposals."
[xxxvii] Peter Hall, Dennis Hardy and Colin Ward, 'Tomorrow, A Peaceful Path to Real Reform, Original Edition with Commentary, Routledge, NY 2003 p.69. "Howard also makes it clear that Garden City is to be consciously planned. There is to be an overall plan, along the lines he has already suggested in Diagrams No. 2 and 3 – modified, as he is at pains to state, to fit local geography".
[xxxviii]C. B. Purdom, The Garden City, J.M. Dent & Sons, London, MCMXIII, p. 22
39 Additions to the original text and illustrations by Howard in the 1964 edition, apparently made by Purdom, strongly urge the reader to ignore any significance in Howard□s text and drawings other than as mere diagrams.

[xl] C. B. Purdom. The Garden City, J.M. Dent & Sons, London, 1963
[xli] In the publication of the 1946 edition of Garden Cities of Tomorrow, with a Preface by C. B. Purdom, appear anonymous text on page 51 and Figures 2 and 3 that do not appear in the original edition of Tomorrow, A Path to Real Reform. Of the editions following the original Tomorrow, A Path to Real Reform, published in 1902 1946 and 1965 as Garden Cities of Tomorrow only the 1902 edition was published during Howard's lifetime. The 1946 and 1965 editions were published after his death.
[xlii] First Garden City Limited in 1902 whose board of directors consisted of established lawyers, bankers, and business persons.
[xliii] The chief characteristics that distinguish the Unwin and Parker version of Garden City from that in Howard's original publication of 1802 are: the Unwin and Parker pattern of curvilinear randomly placed roads and a corresponding generation of varied lot shapes and sizes as opposed to Howard's regulated shapes and sizes to keep all urban functions proximate to each other; an indeterminate often indistinguishable green belt to restrain urban expansion versus the visible perimeter marked by a railway siding in the design by Howard; a mixed random zoning of housing, industry, public and commercial sites and small dispersed parks of the Unwin and Parker plan in lieu of a central common and zoned bands for specific uses of Howard's design; a railroad that bisected the city as does that of the Unwin and Parker rather than encircling rather than encircling as does the Howrd version; the casual attitude of Unwin and Parker to the final limits of growth compared to a planned population limit of Howard's strategy; invariably no or only vestigial agricultural activities of the Unwin and Parker plan instead of active, full scale fully integrated agriculture with the urban community and; Unwin and Parker's sprawling amorphous plan shape

requiring vehicles for mobility compared to the compact circular plan of Howard to enable direct pedestrian access to all activities. These anomalies surely affected acceptance of Howard□s proposals.

[xliv] Eugenie L. Birch, "Five Generations of the Garden City: Tracing Howard's Legacy in Twentieth Century Planning", From Garden City to Green City, edited by Kermit C. Parsons and David Schuyler, Johns Hopkins University Press, 2002, pp. 184,185 "By far the most visible of the fifth generation were the self-declared advocates of New Urbanism, [who] have promoted plans, projects, and writings that express the Howardian ideals…."

[xlv] A condition that has existed for some time between Mexico and the USA as hordes of poor Mexicans daily entered the USA in search of a more secure life.

[xlvi] Ebenezer Howard, Tomorrow, A Peaceful Path to Real Reform, Swan Sonnenschein & Co. London, 1898. P.23

[xlvii] Chichen Itsu, Peru and Banaue, Philippines.

[xlviii] Some will argue that the additional distance incurred by following a contour line that weaves back and forth is greater than the straight-line distance between start and finish of a given journey. However, apart from some existing routes that traverse flat desert, prairie or steppe terrain, most routes follow devious paths for other reasons such as historical precedent, private land obstructions or deviations to avoid difficult existing terrain. In any case following a single contour line across a flat desert, prairie or steppe would also be a straight line. The complexity of existing highway routes in the North East United States illustrates the difficulty of finding the most direct route between two points.

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[l] Vertical standpipes whose water level height can be adjusted can modulate the liquid pressure in Gravity Neutral pipe systems.

[li] . Early circular city examples may have been inspired by such cosmic phenomena as the disc shape of the sun or the circle of a full moon when viewed from the earth. When adopted by ambitious of rulers of early civilizations in the erection of their capital cities the circular configuration, magnified or legitimized their earthly power through affiliation with the mythical powers of the "heavenly bodies". Howard, immediate example was the square shaped scheme of G.S. Buckingham with its square concentrically arranged street system.

[lii] Douglas Fraser, Village Planning in the Primitive World, New York, George Braziller, 1968. pp20-21

[liii] A Social City is used by Howard to describe a collection or coterie of garden settlements linked together to share resources and to support social and economic activities at higher level than can be supported by individual garden settlements.

[liv] Hyperion fabricates refrigerator size atomic plants sufficient to generate enough electricity for a small settlement of around 30,000 and Bloom will go on line with a compact hydrogen fuel cell.

[lv] " ..In 1950 [Kibutz] Mekorot drilled for water near the amphitheater for the dance festival, and from a depth of 374 meters, a powerful stream of water burst forth, supplying 300 cube per hour. After this success, additional drills followed, supplying the precious liquid to Dalia and the settlements in the area. This water is still used today to improve the quality of the water from the National Water Supply System which passes near the kibbutz. Water has brought about an essential change in the character of the agriculture and outlook of the settlement. Lawns, gardens and groves were planted, and the bare land was gradually covered by veils of greenery. Industrial factories were also established and consolidated, supplying the members with a variety of work….." from Wikipedia, 2012

[lvi] Asesh Kumaar Maitraa, Habitat II, No. 5.

[lvii] The width of boulevards can be determined by their proportion relative to the heights of the buildings on opposing sides of the boulevard but are also determined by variations in undulations of the terrain between

boulevard widths. The proportion based on the ratio of mall width to build height such as the Ramblas in Barcelona provides a good guide.

[lviii] The limits of pedestrian travel worldwide depend on an almost limitless number of variables that could include age, lifestyle, cultural inhibitions, quality and kind of underfoot surface and footwear (if any) and so forth.

[lix] Vehicular travel between home and Perimeter Road and Inner Agricultural Zone would not be allowed with internal combustion engine powered vehicles.

[lx] Farmers live within the urban green line and commute daily, as do most urban workers who work within the settlement.

[lxi] The Hawaiian ruling elite.

[lxii] While it may be argued that an existing contour grade will never be a straight line and can never, therefore, be the shortest distance between inter-city departure and arrival, current highway routing characteristically also rarely achieves straight line efficiency in any event. Bridges or tunnels compensate for abrupt directional changes in the contour line.

[lxiii] This can only be achieved by following the Gravity Neutral precept and following the Ahaapua strategy that all fluids carried in Regional Corridors will be transferred by gravity to avoid the use of pumps.

[lxiv] Includes land management, farming, agriculture, agronomy; cultivation; animal husbandry and ranching.

[lxv] Much land zoned as agricultural is irretrievably lost to aggressive developers rezoning land from agriculture to residential subdivisions, speculators holding fallow land for future profit, would be gentry intent on creating sumptuous estates in which no or only token farming takes place, the spontaneous overnight construction of the shelters of the homeless, the relocation of industrial and commercial ventures outside of municipal boundaries and control, are but a few of the examples of the inordinate loss of agricultural in a world in which food shortages become more frequent.

[lxvi] The origins of this method of town planning by subdivisions may be traced back through five generations of planners to the Unwin and Parker plan for Letchworth.

[lxvii] More properly known as Inuits.

[lxviii] Clots of soil impregnated with the roots of grasses that, when placed tightly together grow into homogenous weather resistant roof and walls.

[lxix] These three systems, if evaluated today would likely be awarded a ‘first’ rating by environmentalists.

[lxx]See the film "Dances With Wolves" for excellence pictorial documentation contrasting the Plains Indians sensitive interaction and use of resources of nature with the exploitation of the Plains by American settlers and entrepreneurs

[lxxi]The shortage of aluminum during World War II caused the British to use a similar system to construct an aircraft (bomber) called the ‘Wellington’ by substituting thin strips of wood for the reeds used by the Mongols. So employed, the system proved to be quite rugged and gives credence to the notion that pre-industrial primitive societies were indeed quite sophisticated.

[lxxii] The Igloos of the Inuits were true domes in which the line of compression followed a line of thrust within the thickness of the snow blocks of the dome in what may be one of the earliest examples of a true dome.

[lxxiii] The islands from which the original settlers presumably came.

[lxxiv] "Why the Mayas Collapsed" Newsweek V. CXVII, No. 24,June 17, 1991,P.51

[lxxv] Nancy B. Solomon, “Live/Build/Sustain”, Architectural Record, October 2010. pp110-114

[lxxvi] Also Fukushima, Japan in one month (March 2011) suffered a 9,0 earthquake, a tsunami and a nuclear plant meltdown,

[lxxvii] Disasters of this magnitude are becoming more frequent as populations flock to urban centers and, as is demonstrated by the mishaps encountered in attempting to give aid prove that the world has not yet the capacity to cope with disasters of this scale.

[lxxviii] The Muslim version of a holy war.

[lxxix] The Palestinian uprising against Israeli occupation of the West Bank and Gaza Strip, beginning in 198

[lxxx] A proprietary system of interlocking preformed building components suitable for erecting housing by self-help or mutual aid methods. The system assures housing that is able to resist horizontal forces equal to 7+ on the Richter Scale, winds up to 300 kph and flood and storm surge up to 1.5 meters high; and able to resist a vertical dynamic loads equal to a coconut dropped from 20 meters and of a static load equal to 2 meters depth of volcanic ash and; able to resist fire for one hour from internal or exterior sources;

[lxxxi] Stanley Buder, Visionaries & Planners: The Garden City Movement and The Modern Community, New York, 1990. P.133
[lxxxii] Ebenezer Howard, Tomorrow, A Peaceful Path to Real Reform, Swan Sonnenschein & Co. London, 1898. P. 13
[lxxxiii] 30,000 population 5,500 building lots with 30,000/5500 = 5.45 people per average lot area of 2600 square feet per lot or 477 sq. ft. per person.
[lxxxiv] The number of pseudo-public buildings that came into existence in the Central Park in Manila during the Ferdinand Marcos era amply illustrates encroachment of public buildings into public parks.
[lxxxv]Ebenezer Howard, Garden Cities of Tomorrow, M.I.T. Press, Boston, 1965. p.55
[lxxxvi] Ibid. p. 56
[lxxxvii] Ibid. p. 57
[lxxxviii] Ibid. Figures 2 and 3.
[lxxxix] The curvilinear architecture of Oscar Niemeyar would blend most appropriately with the terrain generated by the precept of Neutral Gravity.
[xc] Ebenezer Howard, Garden Cities of Tomorrow, M.I.T. Press, Boston, 1965. p.55
[xci] Development of newly invented internal combustion powered vehicles at this early stage, gave no indication that the growth of this method of transporting goods and people would increase to such magnitude as to make what was once considered a benefit to become a noxious and life threatening bane to urban life and a significant contributor to the present threat of global warming.
[xcii] These invasions, as exemplified by the many boat and ship crossings of the Mediterranean Sea carrying undocumented migrants from Africa to southern Europe or from Asia to North America across the Pacific Ocean, have been underway for some years and can be expected to swell significantly if the predicted consequences of global warming are realized.
[xciii] The intense cultivation of vegetables, herbs, and small-scale orchard produce by farmers who sell their produce in public market stalls.
[xciv] A term used during World War II to denote the home consumption of vegetables, grown in the front or rear yards of the their homes, by many citizens in the free world.
[xcv] British equivalent of a freight car in North America.
[xcvi] Ebenezer Howard, Garden Cities of Tomorrow, M.I.T. Press, Boston, 1965. p.44

The Morphology

Apart from the amenities of the Garden City described by Ebenezer Howard in his publication of the 20th century such as breathing clean air, an intimate relationship with nature, shopping centers, schools, government offices and public sports and recreational spaces all within easy walking distance, and a stable and sustainable life assured by a fixed population and density on land held in common by the community, there are additional advantageous characteristics not shared with conventional cities and conurbations of in the 21st century. These-include interconnectivity through neutral gravity, security, autonomy and the less apparent advantages of continuity and concentricity.

Connectivity distinguishes the difference of isolated strip developments of housing and supporting functions that are commonly found paralleling and served by main thoroughfares of the cities and conurbations with the concentric Urban Corridors of zones in a Garden City that, by virtue of being circular, can be linked together end to end. While this difference is commonly expressed as a circle, Garden City zones with their respective Urban Corridors, can also be composed of any number of arcs of varied lengths and radiuses that, when linked together, become continuous closed loops. Thus freed from the constraint of a circle, zones become closed loops that can navigate around obstructions or follow curvilinear contour lines without difficulty while still retaining their functionality of a continuous loop. This freedom can be augmented when combined with Gravity Neutral to maintain a uniform flow and pressure throughout entire systems of concentric closed loops. When a leak occurs in a loop, valves on both sides of the leak are closed so that delivery of fluids throughout the rest of the loop remain unaffected. Compared to the conventional branching systems presently used in cities and conurbations to deliver fluids that will, when a leak occurs in a branch or trunk line, cut off delivery of water to entire neighborhoods or sections ol a city.

The morphology of Garden Settlements is confronted by constraints not found in present day urban planning: a stabilized population and density configured to provide reasonable pedestrian access throughout a settlement requires the terrain to be limited with respect to variations in elevation and the distance

between boundaries to be more or less equidistant. Howard correctly determined this to be a circular boundary with social, commercial, educational and recreational functions increasing in frequency as they approached the center of the circular boundary. To fit his planned population of 30,000 within a circular shape would, he determined, require a radius of ¾ of mile. A geometric configuration such as a circular or square urban shape with these dimensions, however, does not fit comfortably into the organic landscape of a natural environment.

A city located on a hillside would likely take a flattened loop configuration. A city located near the top of a knoll or around the rim of a valley could take a circular looping configuration. Both configurations, since they complete a loop, permit the bi-lateral free flow and equal distribution of goods, people, fluids, and electrons around the loop. On an absolutely flat site, such is often found in delta regions, plains and deserts, the most efficient geometric loop that would fit within the confines of the site may be the most appropriate configuration.

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